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AIR FORCE CAMBRIDGE RESEARCH LABORATORIES

L. G. HANSCOM FIELD, BEDFORD, MASSACHUSETTS

Bibliography, With Abstracts, of AFCRL Publications From 1 January to 31 March 1971

AIR FORCE SYSTEMS COMMAND
United States Air Force

MATIONAL TECHNICAL HITORMATION SERVICE Span Jobb, Va. 22131



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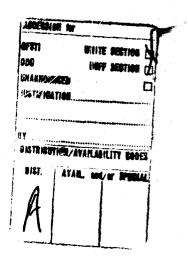
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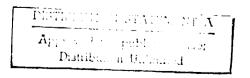
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Bibliography, With Abstracts, of AFCRL Publications From 1 January to 31 March 1971

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AIR FORCE SYSTEMS COMMAND
United States Air Force





Abstract

This bibliography lists all AFCRL in-house reports, journal articles, and contractor reports issued from 1 January to 31 March 1971. Abstracts are included.

	Contents
INTRODUCTION	1
PART I. AFCRL IN-HOUSE REPORTS BY SERIES	5
Air Force Surveys in Geophysics	7
Environmental Research Papers	11
Instrumentation Papers	21
Physical Sciences Research Papers	23
Special Reports	33
Translation Series	39
PART II. AFCRL JOURNAL ARTICLES	45
PART III. AFCRL CONTRACTOR REPORTS	87
INDEX	149
In-Hous€ Reports	150
Journal Articles	151
Contractor Reports	153

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Bibliography, With Abstracts, of AFCRL Publications From 1 January to 31 March 1971

INTRODUCTION

This bibliography lists all AFCRL in-house reports, journal articles, and contractor reports issued during the reporting period. The DD Form 1473 (Document Control Data - R&D) for each publication is included.

In Part I, the 1473's for in-house reports are arranged numerically by the series in which they were issued; in Part II, the 1473's for journal articles are arranged alphabetically by author; in Part III, the 1473's for contractor reports are arranged alphabetically by corporate author. For cross-reference purposes, an index is included, listing the publications numerically by the AFCRL document number.

Types of AFCRL Reports

AFCRL technical reports include those prepared in-house and those prepared by contractors. The in-house reports are issued in six series, and the contractor reports are of two types. The in-house series and the types of contractor reports are described below.

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This series is utilized for two types of environmental research information;

(a) research results that are directly applicable to design, developmental, or

operational problems of the Air Force, and (b) survey or state-of-the-art papers in a specific area of the environmental sciences.

INSTRUMENTATION PAPERS

Instrumentation Papers present information about new techniques, procedures, instrumentation, components, or vehicles utilized in AFCRL research efforts.

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SPECIAL REPORTS

The Special Reports series provides a publication medium for (a) papers that do not report specific research results, such as bibliographies and proceedings of symposia, (b) papers by special employees of AFCRL, such as summer employees or cooperative students, (c) theses written by AFCRL employees, and (d) significant management and administrative reports. Other special categories may be accommodated in this series as the need arises.

TRANSLATION SERIES

This series, including Russian, Chinese, and Japanese works, represents a highly selective collection of translations of scientific and technical articles pertinent to AFCRL interest.

Contractor Reports

SCIENTIFIC REPORTS

Scientific Reports are normally prepared when a definable phase of the research has been completed, when the research effort reaches a point where it is natural and logical to summarize the results, or if no other scientific report was issued during the contract year. Scientific Reports cover all phases of work undertaken during the period of the report, including the contents of papers published in scientific journals or presented at scientific meetings.

FINAL REPORTS

These reports summarize the work performed under the contract.

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Tibetian Highlands and west and west.	western indocnina	i, suggesting a	in initu	ence from the north-	
	ultiple regression	n program, eo	uations	were developed for	
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afternoon, 1230 to 2330					
cloudiness, sea level pressure, and pressure gradients were found most useful.					
Nomograms were made to simplify calculations of the forecasts. Independent test forecasts over the 1969 season showed no skill over recur-					
rence when scored by the Heidke method. Forecasts for 1970 showed skills of					
+0.18 and +0.14 for days +1 and +2, or about the same as those found with the					
dependent data. Scores for the day +3 forecasts were near zero. These scores, although low, are considered important because forecasts for these periods are					
ligially based on recurr	ierea im portant t ence or persister	ecause ioreca	BIB IOP	mese periods are Forecasting	
usually based on recurrence or persistence. KEYWORDS: Forecasting weather Southeast Asia, Southwest monsoon Southeast Asia, Satellite cloudiness Southeast Asia, Radar index Southeast Asia					
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Environmental Research Papers

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13. ABSTRACT					
The mapping of ionospheric parameters for the purpose of extending and extrapolating observations is studied. It is found that a relatively simple contouring program can be used to specify the ionosphere in the lower regions that are under strict solar control. Using electron density data representative of various ionospheric stations in North America, it is seen that the shape of the generated contours for the F region depend upon the location of the various stations. These results seem to imply the need for more sophisticated methods of synoptic representation of the upper level ionosphere.					
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13. ABSTRACT Knowledge and understanding				
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distribution changes during expansion o change affects the scattering characteri			e to know now the	
A determination, in geometric opti			e forward and had	
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(3) an inverse-square decrease, showed				
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tions. As the center point density incre				
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conducting sphere, that of the sech2 dis	tribution lags s	lightly b	ehind, but that of	
the inverse-square sphere never gets c	lose to the resu	lt for a	conducting	
sphere. In forward scatter, the inverse	-square distrib	ution sh	ows the largest	
cross section and a fairly rapid increas	se with center p	oint den	sity, the sech 2	
distribution has an essentially constant				
has the lowest forward scatter cross se	ection, shows a	slight d	ecrease with	
center point density.				
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13. ABSTRACT				
This paper deals with the use of riometers as an aid in ionospheric forecasting during both disturbed and undistrubed conditions at various geographical regions of the earth. Both the physical and technical aspects of riometry are discussed. Riometer observations during special solar geophysical events such as polar cap absorptions, auroral absorptions, and solar flare effects are presented and discussed. Suggestions for the improvement of riometer output and a description of experiments to be performed using riometers as as integral part of forecasting systems are presented.				
KEYWORDS: Riometry, Ionospheric absorption, Polar cap absorption events, Auroral absorption, Solar flare effects				

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12. ABSTRACT Qualitative descripti	ions of the mo	rnhology of PC	A even	ts are given.	

Qualitative descriptions of the morphology of PCA events are given, using data from the following riometer stations: Thule and Godhavn, Greenland; Churchill Range, Manitoba, Canada; and Reykjavik (Leirvogur), Iceland. The dependence of commencement time on solar zenith angle and subsequent daily variations in absorption following the initial day are described. The morphology of PCA events is very important for forecasting the Lehavior of ionospheric absorption during a PCA event. It is shown that besides information concerning the energy spectrum of the proton flux, the season and time of day must also be considered for forecasting the expected absorption.

KEYWORDS: Riometers, Polar cap absorption events, Ionospheric absorption, Morphological development, Auroral absorption events

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The coupled equations representing the horizontal neutral air winds arising from the diurnal variation of atmospheric pressure, are solved numerically. Taking full account of the diurnal and seasonal variation of electron density, meridional and zonal winds have been computed at mid-latitudes for both solar maximum and solar minimum conditions. The daily variation of both the meridional and zonal wind can be well represented by a daily mean plus a 24- and 12-hour oscillation and tabular values of the winds for each season are given for the height of the F2 maximum and for every 100 km interval from 200 to 500 km. These values can be used to readily compute the associated vertical drift velocity at any middle latitude location when account is taken of the local geomagnetic field.					
KEYWORDS: Neutral winds, Ionospheric winds, Drift velocity, Ionization distribution, Coupled equations					

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13. ABSTRACT			-	
The impedance and	radiation prop-	erties of a gro	und-wi	ire antenna are ana-
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KEYWORDS: Antenna, Low frequency, Transmission line,				
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13. ABSTRACT

The purpose of this report is to provide a new clarity of insight into concepts that are involved in the design and understanding of devices which have importance in a wide variety of Air Force applications. The formulas derived herein provide new tools for clarifying the mode operation and optimizing the performance of devices that involve dielectric components. The standard theory of dielectrics that involves the vector D is clarified by expressing its basic but implicity assumption as an explicit postulate. For a dielectric sample with polarization density P(r), a discussion is presented concerning the approximation involved in calculating the external field of the sample from the surface and volume polarization charge densities $\sigma p = P \cdot n$ and $\rho p = -\nabla \cdot P$. If E_B is the field generated by the surface density σp , it is shown that the usual theory of dielectrics is equivalent to the postulate that for a homogeneous dielectric in an applied field E_B , the polarization is related to the field by $P = \chi_0 E$, where the mean field E is the sum of E_B and E_B , and χ_0 is the electric susceptibility. The vector D is defined by $D = E + 4\pi P$, and this definition is shown to be the one implicit in the conventional but sometimes ambiguous treatment. The field of conductors embedded in dielectric matter is discussed in terms of the present formalism, as is the force on, and energy density of, a dielectric body in an applied field. The standard expression $w = -\frac{\pi}{2}P \cdot E_B$ for the energy density w of polarized matter is derived from a microscopic viewpoint, without invoking the vector D.

KEYWORDS: Dielectric, Polarization, Internal fields, Vector D, Susceptibility

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Thermodynamic expre		aloned for desc	rihing ti	he pertinent portions	
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and the allowed limits for					
sive ultra-high pressure-t					
empirical results are employed in predicting conditions for producing high quality					
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Relationships between statistical parameters of the filtered and the original data are derived and found to depend only on the value of ρ_1 . Examples of the effect of the filter on the power spectrum of various types of input data are also given.				
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The need for high-dielectric cons	tant, low-loss,	tempe	rature-stable
ceramic materials for microwave dev			
study of various titanate and oxide mi			
we have developed a material which ha	as a temperatur	e freq	uency coefficient
of 530 ppm/°C and a dielectric consta	nt of 106, comp	arable	to the American
Lava T-96 Ceramic, but has a higher	dielectric const	tant. I	Methods for mixing,
firing, and aging of ceramic materials	s, as well as mi	croway	ve measurement
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These results may be valuable to worl	kers wishing to	pursu	e the development
of zero temperature coefficient mater	ials further.	•	•
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KEYWORDS: Dielectric resonators, High dielectric constant ceramics, Temperature coefficient, Temperature stability

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S. Authorisi (First name, middle initial, last no Charles F. Hobbs Jose Stanwood Ayer Law	ph P. Brazy			
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13. ABSTRACT		<u> </u>		
To improve the reliability decoder was designed, cor correction capabilities und a random error-correcting. The code is in the class of offs between failsafe communicused is a special three procedures used for comporiginated and first report Force Cambridge Research	nstructed, ander stationary (73, 45) cyc difference should detect description uter evaluationed by C. F.	d evaluated for y gaussian nois lic code in a bet cyclic code d efficiency of ion technique fof the experiment. The work Hobbs (now de	r failsase condinary es. Distransfor errental sis an esceased	afe and error ditions. It employs erasure channel. cussed are tradenission rate. Also or correction pursystem and the extension of that
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		L.G. Hanscom Field Bedford, Massachusetts 01730			
13. ABSTRACT					
A new method for a use of simple symmetre integrations involving a been designed to take a in numerical integration to incompatible solution actually succeed in this ments. The method may restoration of damped generating initial grid part of some general of general and may find a porating nonsynoptic darea nesting problems.	nic linear filters, multiple mapping dvantage of the sons and at the sans in the overlaps purpose can on akes use of linea amplitude, and repoint data from bjective analysis pplication in sucata into an object	Specifically so f a grid ne relative simpleme time avoid region. Who is the control of the contr	for use twork of scity of the insether or ned from produce also be aced st The pro-	ma sphere, it has map representation stability that is due not the method will n specific experi- e a maximum useful in ation data as occdures are is that of incor-	

KEYWORDS: Interpolation, Filter, Amplitude restoration,

Damping, Stability, Phase displacement

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Special Reports

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This paper was originally spartial fulfillment of the rethe Degree of Master of Scelectrical engineering from	Air Force Car Laboratorie L. G. Hanscon Bedford, Mass	s (LR) n Field			
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There are many potential applications of computers in which it would be desirable for the user to be able to communicate with the machine in English. A number of experimental computer programs have been written which were intended to have the capability of accepting input in at least a restricted subset of English. Some of these programs have been fairly successful at understanding and answering simply phrased questions on some specific topic. None, however, can deal with more than one type of data base, and none can deal with sentences of very great syntactic complexity.

The theory of transformational grammars represents the linguists' most elaborate attempt to date to formalize the syntactic structure of English. The result of analyzing a sentence according to a transformational grammer is a so-called "deep structure," which expresses various information about the constituent portions of the sentence in a treelike form. In view of the relatively high state of development of the transformational theory, it is natural to use it as the basis for the "front end" of an English-understanding program.

The system discussed in this report provides a general method of interpretation of transformationally parsed sentences for use in question-answering. It is based on a general scheme for using the information contained in the deep structures to interrogate a data base. The primary effort is aimed at handling a wide variety of complex syntactic structures, with particular concern for the problem of embedded structures.

The system provides a general facility for handling syntactic structures, to which a user can add routines corresponding to the specific nouns, verbs, and adjectives he wants to use. The present implementation includes a vocabulary suitable for dealing with sets; the noun, verb, and adjective routines for this area of discourse constitute about 10% of the entire program. KEYWORDS: Transformational grammar, omputers, Man-machine interaction, Semantics, Natural language Computers,

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The L.G. Hanscom Field S&E Awards Meeting, held in the Base Theatre on 3 November 1970, served as the vehicle for recognizing selected outstanding research performed by scientists of the Air Force Cambridge Research Laboratories and those of the Electronic Systems Division. This volume is the collection of eight AFCRL papers (three were jointly authored), and two papers prepared by researchers of the ESD, given at this Meeting. The S&E Awards Meeting was also the forum for informing the RDT&E communities at L.G. Hanscom Field of the significant research completed or continuing in a number of disciplines by scientists of the AFCRL/ESD organizations.						
KEYWORDS: Science and engineering awards meeting						

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This is the fifth in a series of reports on research at the Air Force Cambridge Research Laboratories. The report covers a three-year interval. This report was written primarily for Air Force and DOD managers of research development—and more specifically, for the managers in our Headquarters office, the Air Force Systems Command. But it is hoped that it will be of interest and value to a much broader audience. To encompass this broader audience and to make the content more meaningful, the report attempts to relate, by means of survey discussion, the programs to the larger scientific field of which they are a part. The work of each of the eleven laboratories is discussed separately in chapters with an overall introductory chapter on AFCRL management and logistic activities during the reporting period. KEYWORDS: Upper atmosphere physics, Radio astronomy, Solar astronomy, Optical physics, Meteorology, Information processes, Electronic solid state, Communication, Ionospheric physics, Plasma physics, Godesy, Gravity, Seismology, Geology, Crystallography, Electronic devices, Radiation damage, Microwave acoustics, MM wave propagation, Lasers, Balloon technology, Rocket instrumentation, Signal processing					
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ON THE FOUNDATIONS OF CRYSTAL OPTICS Part 1 - Dispersion Theory Part II - Theory of Reflection	and Refraction		
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No. 2. Postscript 1970 by P.P. Ewald	Laboratories (CA)		
KEYWORDS: Dispersion theory, Reflection, Refraction L.G. Hanscom Field Bedford, Massachusetts 01730			
13. ABSTRACT This two part paper investigates the propagation of light in the v	isible region through a crystalline medium.		
anisotropic arrangement of ordinary (isotropic) dipoles at the existence of double refraction. The value of the computed bi Additionally some features of the traditional "theory of dis "incident optical wave" plays a role but it is shown that in a n should be assumed: The refractivity is shown to arise as an interr	persion" are disclosed and clarified. In the older theories the nedium which extends to infinity in all directions no such wave had property of the medium.		
in the crystaline medium is considered as filling a half-spi	ice and having a plane boundary at $z = 0$. A plane optical wave is		

In Part II, a crystalline medium is considered as filling a half-space and having a plane boundary at z = 0. A plane optical wave is incident on this medium. Because of the linearity of the equations it has to be superimposed on the field originating in the crystal. It is shown that this incident optical wave is actually prevented from entering the crystal because of the modification produced in the field of the crystal by the introduction of a boundary. Boundary waves are found to exist on both sides of the boundary. The higher their order, the more rapidly they attenuate as a function of distance away from the boundary but the zero order waves are ordinary undampted plane waves of vacuum velocity c. The fields outside and inside the medium are connected by the Freznel formulae: These follow from the condition that the optical field inside the medium and the

Material Added 1970. The conclusion that the incident optical field cannot penetrate the crystal boundary, together with a similar conclusion in a paper by Oscen, is the basis of the Ewald-Oscen Extinction Theorem.

The same methods and field transformations developed in this two part paper were applied in two later papers which were published as Parts III and IV. These extend the treatment to the passage of X-rays through crystals. "Postscript 1970" published here indicates the relationship of these four parts and further developments of the subject as well as referencing the papers noted above.

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oscillations generated there form a self-consistent system.

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13. ABSTRACT						
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and $Ne^+ + N_2$, O_2 , CO_2 have	e been measur	ed over an ener	gy rang	e from 3 to 200 °V		
and are compared with valu	ues given by ot	her authors. T	he valu	es were determined		
from measurements of the	•					
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		Bedford, Ma	ssachu	setts 01730			
13. ABSTRACT							
THE MESTRES							
Single-crystal materials currently in the use in various fields of opto- electronics are reviewed from the viewpoint of materials science. The characteristics of crystal-line laser hosts, nonlinear optic crystals, electro- optic crystals, and ultrasonic light diffraction solid media are described. The present status of crystal growth by the pulling method is discussed, and rela- tions between the growth conditions and defects in the obtained crystals are stressed. The necessary steps in the process of device fabrication are analyzed, and some important factors such as phase diagram information, domain structure in oxide ferro-electrics, and laser damage susceptibility are pointed out. Some theoretical treatments of oxide ferroelectric crystals useful for materials scientists are reviewed. KEYWORDS: Single crystal, Opto-electronics, Crystal growth							
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13. ABSTRACT							
This report describes the theory, details and performance of the laboratory prototype of a small-scale Fourier spectrometer to measure the absolute spectral intensity of the radiation from the Earth or other planets in the 10 to 40 μ range from aircraft, balloons, rockets or satellites.							
KEYWORDS: Infrared, Fourier	sp ectromete	er					
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1 REPORT TITLE						
SCINTILLATION BOUNDARY DURING QUIET AND DISTURBED MAGNETIC CONDITIONS						
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Jules Aarons Richard S. Allen						
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boundary of the high-latitude region where intense scintillations at 40 MHz were observed. The quiet-day scintillation boundary reached a lower position of 570 invariant latitude at 2200 LT. Dyson's (1969) recent observations with a Langmuir probe have verified the existence of a lower latitude boundary of small-scale irregularities. The boundary concept has been extended to include the effect of magnetic storms. Observations of satellite beacon signals at 40 and 54 MHz during 1961 to 1966 indicate that the mean change in the lower boundary latitude of the irregularity region is a decrease of approximately 1.60 per unit change in local K index. This is quite similar to the change of 1.80 per unit change in Np noted for the trough position by Rycroft and Thomas (1970). In examining the data available from high-inclination and synchronous satellites, it was noted that the change in latitude with K index is a function of time. The maximum change of latitude as a function of K index, approximately 20 to 30 per unit K, occurred between 0300 and 0600 LT; the minimum change, about 10 per unit K, occurred over a broad interval from 1600 to 0200 LT. If the irregularity structure is produced by an interaction of the plasmapause with the ionosphere, the morphologic behavior of this region of the magnetosphere can be studied by reviewing the large inventory of scintillation and spread F data that has been amassed in the course of ionospheric research. KEYWORDS: Sub-auroral ionosphere, Ionospheric irregularities, Irregularity boundary, Magnetic activity, UHF/VHF fading						
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No.12, pp.2666-2672,	December 1970.	Laboratorie	s (LKC	Ž)
		L.G. Hansco	m Fiel	d
		Bedford, Mas	sachus	setts 01730
13. ABSTRACT				
High altitude cher of the intense backgro emission line detector interference filter in successful field test a	ound light of the sky rs is given. An ins a differential radio	y. A comparis trument incorr	on of a	g an ultra-narrow
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KEYWORDS: Atmosph	nere, Choppers, F	ilters, Optical	syster	ms, Tracking
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Research, Space Physics, V	/ol.75,	Laboratorie				
No.34, pp.7147-7160, Dece	mber 1,1970.	L.G. Hanscon	n Field	-44 - 0150		
		Bedford, Mas	sacnus	etts 01/30		
13. ABSTRACT						
The Flying Ionospheric Cambridge Research Labora flights which examined the caround the oval; two coverec camera photographs taken doval, defined as the band of magnetic conditions ($\Sigma K_p > 10$ Under quiet conditions ($\Sigma K_p > 10$ oval were observed in the morning sector were of evening sector could be eith	atories, made ontinuity of the afternoouring these fluished auror (a) a continuou (10) discontinuou temporal natu	e during the wind he auroral ovalun-evening half aights strongly all arcs, is understood around auities in the od, and evening sure, the discon	nter of l. Two of the sugges ler mo- the geo ccurre sector.	1969-1970 four passed completely oval. The all-sky of that the auroral derately disturbed omagnetic pole, nce of au ra in the Discontinuities in		
KEYWORDS: Auroral oval,	Continuity of	auroral forms	, Magne	etospheric model		
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Research, Space Physics, Vol. 75,	Laboratories L.G. Hanscom					
No.34, pp.6940-6949, December 1,1970	Bedford, Mass					
13. ABSTRACT						
A study of 19-GHz (1.58-cm) solar radio bursts recorded at the Slough Solar Radio Observatory from July 1967 to June 1969 suggests that they can be used as reliable indicators of proton events and of PCA's provided that (a) the peak flux increase during the burst is >50% of the pre-burst values, and (b) that the flux enhancement is >10% for longer than 5 min. The warning period, from the time of the burst to the arrival of the first detectable protons in the vicinity of the earth, ranges from tens of minutes to several hours. There is a further delag of three or more hours to the time of maximum proton flux. Since only one frequency is involved, a proton warning solar radiometer could be fitted to any aeropiane, satellite, or spacecraft to supplement ground observations.						
KEYWORDS: 19 GHz, Solar radio bursts, Burst duration DD, FORM, 1473	, Proton event	indica	tors,			

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certain threshold burst, is a much	rgy in fixed-frequency values, when normali better guide to the inte ak burst intensity itse urst.	zed in terms of ensity of associ	f the pe iated s	eak intensity of the olar proton fluxes
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4. DESCRIPTIVE NOTES (Type of report	and inclusive dates)				
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5. AUTHOR(S) (First name, middle initial,	, last name)				
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pp. 911-915, December	1970	L.G. Hansco	-		
pp. 511 516, Beechber	2010.	Bedford, Mas			
The mean motion of particles in a thunderstorm anvil has been measured at various heights and elevation angles by Doppler radar, using the velocity-azimuth scanning mode of Lhermitte and Atlas with the harmonic analysis scheme of Browning and Wexler. An error analysis indicated that the measurement accuracy, even at elevation angles as high as 80°, is comparable to the inherent radar resolution of 0.9° in direction and 0.6m sec ⁻¹ in speed. The scale of temporal and spatial variability of wind at anv'l height was more than an order of magnitude greater than the errors; consequently, the measurements of anvil winds obtained by Doppler radar are considered to be significantly informative. Estimates of divergence, on the other hand, were quite unreliable at elevation angles >50° and not especially trustworthy at any of the smaller elevation angles. All measurements of divergence, however, showed a trend of increase with greater height in the anvil. Pronounced anomalies in the measured wind components, with respect to the components required by the mean anvil flow, provide a rough map of the intense, upper level outflow of the thunderstorn KEYWORDS: Dopple adar, Thunderstorm anvil, Wind measurement, Divergence measurement					
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The band strengths measured. The data yiel percent. The radiative and estimates are made	ld an electronic c lifetime depends	scillator strements on the rotation	ngth of nal quai	1.7×10 ⁻⁴ ± 10 ntum number
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Vincent J. Falcone, Jr.			ì		
Karl N. Wulfsberg			1		
Samuel Gitelson					
6. REPORT DATE	74 TOTAL NO. OF P	AGES.	75 NO. OF REFS		
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No.3, pp.347-355, March 1971.	Laborator				
	L.G. Hanse				
	Bedford, Ma	ıssach	usetts 01730		
13. ABSTRACT We simultaneously measured at					
We simultaneously measured atmospheric emission and absorption under clear sky conditions at frequencies of 15 and 35 GHz and compared the values with those calculated from the radiative transfer equation. The measurements show that atmospheric attenuation determined from emission and absorption measurements agree within experimental error and that the calculated values of attenuation agree with the measurements on a statistical basis when the Gross form factor is used with the model of a plane stratified atmosphere.					
KEYWORDS: Millimeter waves, Atm		on 	fied		
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4. DESCRIPTIVE NOTES (Type of report and inclusive dates)						
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11. SUPPLEMENTARY NOTES Reprinted from Applied Physics Letters	Air Force Ca					
Vol. 17, No. 10, pp. 426-427,	Laborato					
15 November 1970.	L.G. Hansco		• .			
	Bedford, Massachusetts 01730					
13. ABSTRACT						
A study of p-type silicon shows that (1) the annealing temperature of electron-irradiation damage increases as the acceptor concentration increases and (2) the isochronal annealing behavior of damage in samples with gallium and aluminum impurities is different from that in boron-containing samples, which show a higher annealing temperature.						
KEYWORDS: Radiation effects, p-type silicon, Annealing, isochronal Electron irradiations						
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EFFECT OF AXIAL RA	TIO CHANGES O	N THE ELAST	TC MC	ONA LIUO
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E.S. Fisher				
M. H. Manghnani				
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Physics, Vol.41, No.13 December 1970.	s, pp.5059-5062,	Laboratori L.G. Hansco		•
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13. ABSTRACT				
Gerlich has shown				
hydrostatic pressure de Gruneisen γ's at both ni				
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however, large differen				
dC44/dP. It is propose				
c/a ratio with hydrostat	ic pressure beca	use of a large	depen	dence of C ₄₁ on the
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thermal-expansion cond	itions. The effec	t of $\Delta(c/a)$ is	not for	and in tetragonal
TiO ₂ , rutile, where γ H				
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KEYWORDS: Elasticity,	Gruneisen paran	neter, Therma	l expa	nsion
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Reprinted from Bioc Biophysica Acta, Vo 1970.	himica et 1,223, pp.444-446,	Air Force Ca Laboratori L.G. Hansco Bedford, Mas	mbridge Re es (PHF) m Field		
The photoactivity of active bacteriochlorophyll and the absorption spectrum of bacteriochlorophyll absorbing at 800 nm are temporarily lost at low pH but partially regenerated by increasing the pH within a certain time limit. This pH-induced modification and regeneration of these bacteriochlorophyll molecules indicate the contribution of protein conformation in their environment to their spectral and photoactivity characteristics.					
KEYWORDS: Absorp Bacteriopheophytin, DD 1 FORM 1473		on		ohyll,	
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Letters, Vol. 5, No. 2, p	p. 101-104,	Laborato				
1 March 1970.		L.G. Hansed				
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Nitric oxide has bee supersonic stream of hy headglow was observed i of magnitude the intensit vibronic bands of the A	drogen atoms in a in which the emis	an inert carric sion intensity	er. A exceed	chemiluminous led by three orders		
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Journal of Geophysical Research, Space Physics, Vol.75, No.34, pp.6959-6965, 1 December 1970.	Air Force Ca Laborator L.G. Hansco	ies (LĬ	KO)			
	Bedford, Mas					
13. ABSTRACT						
Measurements of solar extreme ultr range 1310-270 A have been made from t over a solar rotation period was obtained elements in various stages of ionization. atmospheric absorption, the accuracy of of the results we previously obtained wit rocket vehicles.	he satellite Ose for emission I Since no corre these results i	o 3. The lines re ection n s super	he flux variation epresenting leed be made for rior to the accuracy			
KEYWORDS: Solar extreme ultraviolet, S	Solar activity	<u>-</u>				
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Using an independe	nt derivation by l	Kohn, the full:	meanin	g of Kato's		
formulas for upper and						
shown. These bounds a						
on a particular eigenva						
of the neighboring eiger	ivalues to the one	in question,	This wa	s asserted by Kato		
but not proved. A comp	arison is made o	f Kato's bound	s with t	hose derived in		
papers by Stevenson an	d Crawford and b	y Cohen and F	eldman	n. Under the con-		
ditions which result in l						
and Cohen-Feldmann be available these bounds	ounds reduce to the	nose of Kato. V	wnen m	iore information is		
cise the recent work of	Walmeley and C	ohen-Feldman	s. Inte	e results appear to		
prove in general the gr	eater accuracy of	f the Stevenson	-Crawi	ford and Cohen-		
Feldmann bounds over	those of Kato. A	general discus	sion of	all three sets of		
bounds is given in term	s of the paramete	er λ appearing	in the	Stevenson-Crawford		
bounds is given in terms of the parameter λ appearing in the Stevenson-Crawford formulation.						
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The vaporization of N	a ₂ O(c) has been	n studied mas	s spect	rometrically. It
was found that the vaporize	_			
and Na, O(g) being minor v			_	
Na ₂ O(c), Na ₂ O(g), Na(g),				
$\Delta \text{Hf}_{298}^{\text{O}}[\text{NaO(g)}] = 24.3\pm 4$				
Those volume will D O/No	(O) = 60 3±4 1-2	al/mal (2 614	ህ 3ህ ሚ	V) and D O(No O) -
These values yield D ₀ (Na				
119, 8±3 kcal/mol (5, 20±0,				
Na ₂ O [†] were measured and	d found to be 6.	5 ± 0.7 and 5.5	5±0.5	eV, respectively.
These appearance potentia	ds are suggest	ed to be close	to the	true ionization
potentials of the molecules	s. Implication	s of these res	ults re	garding some
recent beam experiments	-			_
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A Two-step ionization and excitation model is proposed as an alternative mechanism to the commonly accepted direct-excitation one for the generation of ionic meteor spectra. A near-resonance criterion is invoked to indicate when this mechanism is expected to predominate. The implications of the model are calculated in a slip-flow "threshold" approximation. That is, first and second collisions of atmospheric molecules as well as first collisions of vapor atoms are taken into account. Qualitative agreement with observations is obtained. The model is then applied specifically to the example of the bright Ca II spectra, which are enhanced by this mechanism over the direct-excitation mode.					
KEYWORDS: Ion spectra, Collision dynamics, Atmosphere, Meteors					
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The spectral dependency and polarization were measured for visible light scattered from polydisperse distributions of ice crystals grown in a laboratory cold chamber. Within the limits of experiment—accuracy, there was no discernable spectral variation in the shape of the scattering diagram. The polarization was small but discernable, having a negative value in the region of the 220 halo and a broad positive peak near 1150.					
KEYWORDS: Polarization, Ice crystal, Light scattered ice crystals, Nephelometer					
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Research, Vol. 76, No. 2, pp. 1028-1038, February 1, 1971.	Laborat L.G. Hansco		
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13. ABSTRACT			
Photoionization of the metastable Og	$(1\Delta_{\pi})$ molecul	e has i	been proposed as an
important source of ionization in the D r	egion. The war	veleng	th region of interest
is from 1027 to 1118 A, where ground st			
incident solar flux but is not ionized itse	lf. This paper	prese	nts improved ion
production rates based on new laborator	y data, includi:	ng new	$O_2(1\Delta_g)$ photoioniza
tion cross sections and more detailed cu			
Recent solar flux measurements reduce			
of 5. This reduction is partly compensat			
Si III multiplet, which is at the deepest () ₂ window (110	8.2 A,	mininum cross
section = 4.4×10^{-21} cm ²) and by the ne generally larger than the previously ass	w ionization cr	uss se An ima	ortant factor not
previously considered is absorption by c	antou values. 1 arbon dioxide	which	has a much larger
absorption cross section than ground sta			
level mixing ratio has been assumed. The	ne ion producti	on rate	es are somewhat less
than Hunten and McElroy's [1968] curve	s if CO2 is not	includ	led, With CO ₂ , a
production rate of 1 ion cm ⁻³ sec ⁻¹ is r	eached at appr	oximat	ely 80, 34, and 86km
for zenith angles of 00, 450, and 600, re	espectively. "I	ınten a	and McElroy find this
rate to be 10 to 15 km lower. Concentrat	ions of Of are	calcu.	lated for a zeni.h
angle of 450 for a variety of conditions, atmosphere with 5 ppm H ₂ O.	incidental a dry	aimo	sphere and an
KEYWORDS: Photoionization, Ionospher	e. Metastable	OXVøen	. Carbon dioxide.
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AN IMAGE SELECTION	DEVICE FOR US	SE WITH A TE	LESCO	PE	
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13. ABSTRACT		<u></u>			
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Charles L. Hyder					
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Reprinted from Solar Physics pp. 196-203, 1970. KEYWORD coronal shocks, Solar atmosph Solar physics	Vol. 14, Air Ford S: Solar Laborate, L.G. Ha	oratories (L Inscom Fiel	ge Research M) d		
Solar physics 1. ABSTRACT I find that a one-dimensional strong coronal shock (M _S ≥ 3; will grow outward until the Mach number (M _S) ceases to increase with height (dM _S /dh=0). The shock is driven by the pressure gradient and it is damped by gravity and by energy losses (radiative and conductive). The driving and damping terms reach equilibrium for M _S ≃ 4. Standard shock jump conditions for M _S ≃ 4 lead to post-shock temperatures in the corona in the range 10 ⁷ to 1.3×10 ⁷ K and emission measures from 3.8×10 ⁴⁷ to 3.8×10 ⁴⁸ cm ⁻³ . For isolated simple events, I predict an exponential decay of the emission measure with decay times in the range 1 1 to 6 keV X-ray data with 7.7 to 12.5 keV X-ray data (the 'thermal' component) and finds ranges for the temperatures of 1.2×10⁷ to 1.8×10⁷K, for the emission measures of 5.1×10⁴⁷ to 3.8×10⁴⁸ cm⁻³ and for the decay times 0.5 ≤ τ ≤ 20 min. He also finds that the emission measure varies "both from event to event and within the event, by more than a factor of two". The agreement between the predictions and the observations makes it appear that a strong shock in the corona will produce a post-shock state that yields the observed characteristics of the soft component of X-ray bursts (the 'thermal' X-rays). I give several examples where sprays and fast eruptive prominences(M≃1), that are not associated with solar flares, are associated with 'thermal' X-ray bursts. There were two slow eruptive prominences (M≪1) in the sample, and neither of them yielded a detectable X-ray burst.					
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pp. 147-156, 1970. Laboratories (LM)							
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13. ABSTRACT							
We consider the effect that cohere	nt motion has on	the ob	served brightness				
of moving clouds above the photosphere. We find that steady state clouds (constant							

 N_e and T_e) that are moving perpendicular to the line of sight will appear brighter in $H\alpha$ for speeds between 8 and 100 km/sec and dimmer for speeds greater than 135 km/sec. The brightening and dimming are due to apparent Doppler shifts of the respective $H\alpha$ absorption and the Lyman- α emission profiles 'seen' by the absorption profile of the moving cloud.

We apply this analysis, along with optical depth and geometrical considerations, to the observed brightness variations of the 1 March 1969 limb eruptive prominence. We find that all of the observed brightening and dimming can be explained by the motions, and that no significant change in the prominence N_e or T_e was necessary during the observed H_α event. This conclusion is significant in interpreting and X-ray burst that began as the prominence velocity increased abruptly at the time of maximum $H\alpha$ intensity. The 'thermal X-ray' peak occurred 150 sec later when the prominence had become faint again. There was no associated flare that was visible in $H\alpha$. We discuss the relative brightness of $H\alpha$ and D_3 in a specific moving prominence knot.

We note that the observed range of limb speeds (30-150 km/sec) may be due to the combined $H\alpha$ Doppler brightening and Lyman- α dimming effects. We also discuss generally the Ha brightness of disk surges (bright and dark) and flares, and sprays and puffs that occur at or near the limb.
KEYWORDS: Solar spectroscopy, Solar physics, Solar chromosphere

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SPECTRAL ANOMALIES DUE TO INHOM	OGENEOUS O	PTICA	L PUMPING			
IN THE RUBY LASER						
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Jerald R. Izatt						
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October 1970.	L.G. Hansco Bedford, Mas					
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13. ABSTRACY						
The output of a ruby laser operated	near threhold a	at liqui	d-nitrogen			
temperature normally consists of one or	more longitud	inal co	vity modes			
near the center of each member of the R	1 doublet. The	e nomi	nal doublet			
spacing is 0.38 cm ⁻¹ , but by macking a	portion of the	ruby ro	od from the			
pump radiation the separation of the lase						
significantly below that value. For example,						
of a 5.08×0.64-cm ruby rod has been of ponent separation of only 0.20 cm ⁻¹ . T	his naver pres	nte tr	laser com-			
spectra for masked rubies and also pres						
laser spectra and fluorescence spectra						
conditions. The latter provide insight in	observed dider	isms r	esponsible			
for the observed anomalies, and a theor						
the principal features of the observation.			-h-a -ohaurr			
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KEYWORDS: Lasers, Inhomogeneous of	KEYWORDS: Lasers, Inhomogeneous optical pumping, Ruby laser					
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WIND SPEEDS AS MEA INFLUENCED BY TOW		AND SONIC AN	i:MON	IETERS AND
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13. ABSTRACT		l		
Wind tunnel and field experiments have shown that the fast-response three-component sonic anemometer is a highly accurate wind speed sensor. When sonic anemometers were used as reference sensors for wind speed, slower response cup anemometers were found to consistently overestimate the wind speed. Despite measures taken during a field program in Kansas to minimize tower influence on wind measurements, the errors due to the tower effect on the windward side are inferred to be about ±5% of the observed wind speed ratios of cup to sonic anemometers. When the observed speed ratios are compared with the errors due to tower influence, the overspeeding of the cup anemometer is estimated to be about 10% of the reference wind speed.				
KEYWORDS: Cup anemometers, Sonic anemometers				
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S REPORT TITLE				
THE DISCOVERY OF A SILICON CARBIDE SINC	2H-3C SOLID STA SLE CRYSTALS	ATE TRANSFO)RMA'I	TION IN
4 DESCRIPTIVE HOTES (Type of report				
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1971.	·	L.G. Hansco Bedford, Ma		
13. ABSTRACT		<u> </u>		
Needle-shaped single crystals of 2H (wurtzite type) SiC, grown by a vapour-liquid-solid mechanism, are transformed to the 3C (sphalerite type) structure on annealing in argon at temperatures above 1400°C. The temperature at which the structural transformation is induced varies from one crystal to another ranging from 1400°C to 1800°C. The structure of the crystals before and after the heat-treatment was identified by X-ray diffraction photographs. The discovery of this transformation explains the absence of the ABABpacking in the structure of SiC polytypes formed at high temperatures above 2000°C and suggests that cubic SiC is the stable modification, at least over a temperature-range from 1400°C to about 1800°C.				
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EMISSION SPECTRA OF PARTICULATE SILICATES UNDER SIMULATED LUNAR CONDITIONS							
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Research, Vol. 75, No. 32, pp. 6539.	Air Force Cambridge Research Laboratories (PHL)						
6548, November 10, 1970.	L.G. Hanscom Field						
5515, MOVELINET 10, 1810.							
	Pedford, Massachusetts 01730						
13. ABSTRACT							
Infrared spectra have been acquired under simulated lunar conditions that demonstrate that, contrary to popular belief, features of high spectral contrast are available for small-particle-size samples. The spectral information occurs in the form of emission maxima that are associated with the principal Christianser frequencies, and these maxima are diagnostic of gross composition. The features represent a 5 to 30% effect, depending on particle size and composition. The effect is explained in terms of the sharp thermal gradients produced close to the surface under lunar conditions.							
KEYWORDS: Emission spectra, Silicates, Lunar							
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JAMES FRANCK AT GÖTTINGEN				
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5. AUTHORIS) (First name, middle initial, last name) O. Oldenberg				
6 REPORT DATE February 1971	74 TOTAL NO. OF PAG	ES 76 NO. OF REFS		
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Reprinted from American Journal of Physics, Vol.39/1, pp.41-43, January 1971.	Laboratorie L.G. Hanscon	mbridge Research es		
These recollections were written at the request of the Project on the History of Recent Physics of the American Institute of Physics. The author was "head assistant" to James Franck from 1922 to 1930. Discussion of Franck's methods of thought centers around Klein-Rosseland processes (impacts of the second kind) and the Franck-Condon principle.				
KEYWORDS: History of physical science, James Franck and atomic and molecular theory, Franck-Condon principle, Ionization and dissociation processes in molecules, James Franck and Otto Oldenberg at Göttingen				
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STUDY OF ION-NEUTRA DOUBLE MASS SPECTR		WITH A TIME-	·OF'-F'I	LIGHT	
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Mass Spectrometry and		Laboratori			
Vol5. pp.113-126, 1970.		L.G. Hanscon Bedford, Mas			
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13. ABSTRACT					
The times-of-flight					
neutral reactions are me	easured using a l	ongitudinal dou	ible ma	ass spectrometer	
	system. This system consists of a 2.54 cm 90 degree magnetic sector ion beam selector, a collision chamber and grid system, and a 46 cm quadrupole mass				
filter, together with a m					
per channel, that serves	as a flight-time	recorder Re	actant	ions are produced as	
a pulsed beam by applyir					
The time-of-flight of the	se ions to the co	llision chambe	r is of	ntained by measuring	
the delay between the pul					
close to the collision cha					
of the reactant and produ	ct ions through	the collision ch	namber	grid system, and	
mass filter are then obta	ined by differen	ce. The appara	atus ha	s been used to study	
ion-neutral reactions in					
of product ion energies f	rom thermal to	about 150 eV.	Consid	eration of the source	
of error indicates that th	ie system is mos	st useful for the	e range	e of ion energies	
from thermal to a few tens of eV. Results obtained in the study of three ionneutral reactions are presented. These are $Ar^+ + Ar \rightarrow Ar + Ar^+$, $CO_2^+ + CO_2 \rightarrow CO_2$ + CO_2^+ , and $CO_2^+ + CO_2 \rightarrow CO_2^+$.					
neutral reactions are presented. These are Ar ⁺ + Ar→Ar+Ar ⁺ , CO½ + CO ₂ →CO ₂					
$+CO_2^+$, and $CO^+ + CO_2 \rightarrow CO + CO_2^+$.					
·					
KEYWORDS: Ion-molecule, Mass spectrometer, Time-of-flight					
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140.12, pp.2106-2186, L	ecember 1910.	L.G. Hanse				
		Bedford, Ma				
13. ABSTRACT						
A method has been	donalamad of donal	ing the female.	man 4 n 1	ahanumtian		
A method has been of solids directly from e	ueveloped of deri	ving the funda.	out hass	ausorption spectra		
computational evaluation	. These charac	teristic lattice	absorn	ntion spectra		
represent the true energ	gy absorption spe	ctra of solids.	As op	posed to the tra-		
ditional absorption coeff	icient (k) vs freg	uency curve,	which is	s regarded as the		
absorption spectrum for	solids in the reg	gion of anomal	ous dist	persion, the spectra.		
as derived by the propos	sed method, clea	rly resolve the	transv	erse and longitudinal		
modes of vibration. The damping. The method u	ey also exhibit th	e characterist	ics of a	inharmonicity and		
single-crystal and thin-	ises uie combined film specimene	Its validity be	u iransi is heer	mission data on verified on a wide		
variety of solids. The	nost recent data	obtained from	emissi	on, laser-Raman		
or cold neutron scatteri	ng techniques, is	in complete a	greeme	ent with the derived		
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directly from elastic co	nstants, is also a	advanced. It is	simult	aneously used to		
render further support f	or the developed	characteristic	energy	y absorption spectra.		
solid state physics.	The importance of these spectra is discussed with regard to some problems in					
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13. ABSTRACT					
An exact longitudinal wave solution of nonlinear equations for a cold and collisionless one-fluid magneto plasma has been obtained. The wave is found to be anharmonic (non-sinusoidal) in form and its amplitude involves an arbitrary parameter. By means of a pseudopotential well, the domain of nonlinear oscillations is defined and the maximum amplitude up to which a nonlinear wave can grow is determined. Intensity of the equatorial sporadic-E irregularities is computed and the coherent energy density is found to be of the order of 10 ⁻⁹ erg/cm ³ .					
KEYWORDS: Nonlinear plasma waves, Ionospheric irregularity					
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pp.361-379, 1970.	L.G. Hanscom Field Bedford, Massachusetts 01730			
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13. ABSTRACT				
A theory of hydromagnetic propagation is developed for the case in which the isotropic and guided modes are coupled. The hydromagnetic wave equation, including ioncyclotron terms, is derived and is applied to the cylindrical geometry of the MHD wedge. The low frequency, axisymmetric case, which corresponds to weak coupling is considered in detail. A steady state solution is obtained which involves the formation of a period-dependent, reflecting barrier. This barrier, a direct result of the toroidal resonance, confines the wave energy to definite regions within the magnetized plasma. The numerical results obtained for this particularly tractable model are applied by analogy to the plasmasphere. The anticipated spectra and the associated latitude effects are displayed for both bounded and open systems.				
KEYWORDS: Hydromagnetic waves, Magneto sphere, Resonances				

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The ionospheric spectrum of the critical frequency of the F ₂ region, f ₀ F ₂ , is studied in detail at 35 locations during solar maximum and at 21 stations during solar minimum. The spectra contain prominent lines superposed on background continua. The most prominent lines correspond to solar periods of 24,12, and 8 hours. Lines at half a lunar day (period of 12,48 solar hours) and at two lunisolar periods have also been detected in all the spectra investigated. The lunisolar lines have statistically significant amplitudes only at the low-latitude stations. Our analysis indicates the influence in the F region of plasma transport processes such as EXB drift, ambipolar diffusion, and iondrag effects of the neutral air wind generated by the thermospheric diurnal density variations. An assessment of the roles of some of these processes is attempted in terms of the results obtained from our analysis.				
KEYWORDS: Tidal effects (F region), f_0F_2 , Spectrum analysis, Ionospheric dynamics, Solar cycle variations				
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pp. 954-955, December	1970.	L.G. Hansco		
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13. ABSTRACT				
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13. ABSTRACT				

The temperature and frequency dependence of the attenuation of 0.5-5-GHz acoustic surface waves on LiNbO3 has been measured. For propagation in vacuum a frequency-squared dependence of the total attenuation is obtained with a value at 1 GHz of 0.9 dB/ μ sec. Temperature-dependence measurements using a novel three-transducer technique show the dominant loss (0.7 dB/ μ sec at 1 GHz) mechanism to be the interaction with thermally excited elastic waves. Propagation in air results in an additional loss linearly proportional to frequency with a value of 0.2 dB/ μ sec at 1 GHz. The effects of beam steering and diffraction losses are also investigated both theoretically and experimentally. Both misalignment of transducers with respect to pure mode propagation axes and misalignment of the propagation-plane perpendicular can add significantly to delay line insertion loss. This beam steering loss on Y-cut Z-propagating LiNbO3 is considerably higher than on the 41.50 rotated-cut X-propagating orientation. The loss mechanisms measured in this paper are sufficient to completely account for the insertion loss of surface-wave delay lines.

KEYWORDS: Three transducer method, Temperature dependence of attenuatic. Air loading of microwave acoustic surface waves, Frequency dependence of attenuation, Loss mechanisms in microwave acoustic surface waves

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No. 5251, pp. 1149-1152, J	une 20, 1970).	Lalorator			
		L.G. Hanscon Bedford, Mas			
13. ABSTRACT					
Measurements of the 7 March 1970 solar eclipse were made by AFCRL at the Sagamore Hill radio observatory on the frequencies of 35 GHz, 15 GHz, 8800 MHz, 4995 MHz, 2695 MHz, 1415 MHz, 606 MHz, 245 MHz and 114 MHz. The brightness temperature spectral index, γ , derived from T_b = afy showed that the residual temperatures at maximum obscuration (m = 0.96) had an index of -1.5, which indicated a flatter temperature spectrum than was associated with the 12 November 1966 eclipse where γ = -1.9. A similar flattening of spectrum occurs with daily total sun values during periods of high solar activity. The flux spectrum of the radio source associated with McMath plage 10607 is illustrated and shows a peaking of 10.9 flux units to occur near 6.0 CM wavelength. Brightness, temperatures of the region as well as its associated optical development are described.					
KEYWORDS: Solar eclips	e, Radio astro	nomy, Active	regions	s, Source spectrum	
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No. 34, pp. 7299-7302,	December 1970	L.G. Hansco		
		Bedford, Mas	sachu	setts 01730
13. ABSTRACT 9				
Difficulties concerning the creation of ${\rm H_3O}^+$ · ${\rm (H_2O)}_n$ ions in the D-region are discussed. It is suggested that the formation of these ions may be related to the chemistry of methane.				
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KEYWORDS: Ionospher Ionospheric chemistry	re, D-region, Me	sosphere, Atm	osphe	ric ionization,
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	7-2598, November					
13. ABSTRACT						
A significant gain in signal-to-noise ratio for photodiodes and avalanche photodiodes is realized by bootstrapping the device capacitance. A specific example is detailed for the detection of 6328 Å light modulated at 30 MHertz. The signal-to-noise ratio gain in this example is 9 db and 3 db for the photodiode and avalanche photodiode respectively, so that, the signal-to-noise ratios for the photodiodes are superior to that of a photomultiplier when the light intensity is greater than .05 microwatts for the avalanche photodiode and 1 microwatt for the photodiode.						
KEYWORDS:	Photomultipliers,	Photodic	des, High spe	ed ligh	nt detection	
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tube, Oscillator strengt	ns, Spectra,	Bedford, Mas	ssachus	setts 01730	
13 ABSTRACT					

Absolute gf-values for 118 Fe I lines in the visible region of the spectrum have been measured by shock-tube emission spectroscopy. Special attention was given to choosing relatively faint lines in a region of reasonably well-defined solar photospheric continuum and to eliminating systematic errors. For the latter purpose, the gas kinetic temperature was measured accurately by an ultrasonic technique for every shock, and a special study was made in which the various experimental parameters were varied over extreme ranges and in which the validity of the assumptions of local thermodynamic equilibrium (LTE) and of optical thinness were verified. Our results are in fairly good agreement with Corliss and Tech's free-burning-arc measurements for low-excitation lines but show large disagreements for lines having high-excitation potentials. The magnitude of the discrepancies is largely dependent upon upper excitation potential and to a lesser extent upon wavelength. Our measurements for low-excitation and high-excitation lines agree to within a factor of about 2 with values obtained by other independent investigations, which include shock-tube, wall-stabilized-arc, atomic-beam, and beam-foil measurements. These results suggest that the solar photospheric abundance of iron may need to be revised upward in the light of the various recent measurements of gf-values for high-excitation lines, which are consistently smaller than reported free-burning-arc values by nearly 1 order of magnitude. These free-burning-arc f-values and the furnace-absorption f-values upon which they are based have repeatedly led to the paradox of solar photospheric iron abundance about an order of magnitude lower than coronal. According to a line-profile fitting analysis by Ross(1970), our Fe I gf-values corpo, some 1473 respond to an increased photospheric abundance by a factor of about 5.

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S. AUTHORIS) (First name, middle initial, last name) Donald H. Fryklund					
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and flight testing of several rot	or stabilizer systems.				
KEYWORDS: Sounding rocket, Stability,	Dual-spin stabilization				

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KEYWORDS: Perylene iodine	L.G. Hans		
	Bedford M	assachuse	tts 01730
Conditions for the single crystal pro	eparation of		
er compounds and the nitro-derivatives of flugated. Ternary phase relationships for the per			trile have been investi- isulfide system have
heen obtained at 250C and 350C. Smoothed se	dubility curs	es for the	P(I) P(I) and
been obtained at 25° C and 35° C. Smoothed so $(I_2)_2$ species are presented for both 25° C and	135°C The	enluhility	712/10/12/12/3/
methylene - 2,4,7 trinitrofluorene and 9 - dic	vano-methyle	ne 2.7 di	nitrofluorene in acetoni
trile have been determined and the conditions			
sented.	, ,		
The free energies of formation, hea	ts of formati	on and ent	ropies of formation hav
been deduced for the $P_7(I_2)_{10}$, $P_2(I_2)_3$ and $P(I_2)_{10}$), species f	rom the so	lubility data and pre-
vious gas-solid reaction studies. 2 3	. s		
The factors which hinder the crystal			
have been identified as extremely small solub	•		-
bility with temperature. The requirements for		-	
ques for growing single crystals of these mate			
tions on the allowed temperature gradients and			s which will prohibit
the onset of dendritic growth through constitut			
Results from the program indicate the			
of both the perylene-iodine compounds and the			
onitrile will require extremely close control of gradients and use of growth solutions of six li		•	and temperature
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5. AUTHOR(S) (First name, middle initial, last name)				
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	L. G. Hanscom			
	Bedford, Massachusetts 01730			
13. ABSTRACT				
This report is the concluding sci progress of Scientific Analytical Investiga Programs, Data Reduction, and the developme niques in support of Environmental Research chysical sciences concerning the upper atmo During the year covered by this r in complexity and size from conversion of p system to another, to analysis and developm programs.	tions, the prepa nt of mathematics and other various sphere. eport, the 50 con rograms from one	ration of al and con us aspects mpleted po language	Computer mputer tech- s of the rograms ranged or computer	
KEYWORDS: Climatology, Trafficabili	ity, Areal prec	ipitation		

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SATELLITE EXPERIMENT PROCESSOR SYSTEM							
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Leonard L. Dalton Arthur J. Ma Richard H. Desrochers David T. Wil							
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	Air Force Cambridge Research						
TECH, OTHER.	Laboratories (SU) L. G. Hanscom Field						
	Beaford, Massachusetts 01730						
13. ABSTRACT	<u> </u>						
In an effort to circumvent the difficulties and effort involved in reducing and processing the telemetry data from a broad class of differing space vehicles, and Analysis and Simulation Branch (SUYA) of the Air Force Cambridge Research Laboratories (AFCRL) at L. G. Hanscom Field, Bedford, Massachusetts, has been engaged in the development of a Satellite Data Reduction Processor System (SADAR) (as described in AFCRL-67-0561) to provide a general and flexible computer programming system capable of handling the raw data from diverse vehicles.							
This report describes a system to pro Satellite and the display of the various en	perimental results.						
KEYWORDS: Commutator, Computer pro	gram, Computer programing system						
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& PROPAGATION				
4. DESCRIPTIVE NOTES (Type of report and inclusive dates)				
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5. AUTHORIS) (First name, middle initial, last name)				
Ronald L. Fante				
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	L. G. Hanscon			
13. ABSTRACT				
Approximations have been considered which lead to a simplified model for non-linear microwave breakdown. Using the simplified model we have then analytically considered the propagation of a high power plane wave into a steady state (' ' ' ' ') gaseous half-space. We have also presented numerical results for the non-steady state case (' ' ' ' ' ').				
KEYWORDS: Non-linear propaga	tion, Microw	ave b	reakdown	

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Department of Physics		25. GRO	UP	
Potsdam, New York 13676		L		
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G. Thomas Huetter				
Stephen M. Yushak	74 TOTAL NO. OF PA	688	75. NO. OF REFS	
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}	Bedford, Mas			
13. ABSTRACT	Decadio, Mai	3340400		
Advances in instrumentation based on	the events about			
Advances in instrumentation based on	une spark-chamb	er teenn	ique for making	
charged particle studies of the aerospace en	nvironment have i	ncluded	the development	
of (1) spark-discharge modules that are sea	lad soginet the en	aca anvi	ironment (2) a	
1	•			
high-voltage generator with a long lifetime	for use with spark	chamb	ers in space, (3)	
a passive readout technique for spark-disch				
ing a clearing field that consumes no power	. Analytical expr	essions	have been	
derived for the flux of protons within cylindrical shell and slab disk shields exposed				
to protons in space. Reported also are studies in space radiation dosimetry.				
KEY WORDS: Spark Chamber Spectrometry, Proton Spectrometer, Spark-Discharge				
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EVALUATION OF AIRBORNE ELECTRO	MAGNETIC	SURVEYI	NG FOR MAPPING
VARIATIONS IN ROCK STRENGTH			
* DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific. Final 1 March 1969-1 July 19	970 approve	d 30 Dece	mber 1970
5 AUTHOR(\$) (First name, middle initial, last name)			
George V. Keller			
Andre B. Lebel Evan L. Ausman, Jr.			
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TECH, OTHER	i	_	. G. Hanscom
1201, 011121	Field, Bedf		
13 ABSTRACT			
The objective of the study that is the			
f_{ϵ} asibility of estimating variations in grou	_		
ductivities measured from the air. A rev	iew of the lit	erature i	ndicates that for a
wide variety of crystalline igneous rocks,		_	
exist between resistivity and strength. The			
techniques hold promise for measuring gr		•	-
These are, in order of the ease with which			
modified systems, the wave-tilt method, t	the long-grou	unded-wir	e method and the
INPUT method. The wave-tilt method ma			•
cast stations in the frequency range from	15 to 30 KHz	, and is	useful with no modifi
cation of commercially available equipmen	nt, as field t	ests desc	ribed in this report
indicate. The long-grounded-wire method	l mikes use	of fields i	from a current-
carrying cable installed specifically for a	survey. Th	e INPUT	method makes use of
a transmitter carried on the aircraft with	the receiver	. Howev	er, in order to mea-
sure conductivities in the range of interes	t with the ex	isting cor	nmercial INPUT
system, major modifications would be req	quired.	•	
KEYWORDS: Rock strength, Str	rength var	iations,	Wave tilt

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CAUSES, EFFECTS AND DIAGNOSTIC MEASURE	MENTS OF THE R	REENTRY PI	LASMA SHEATH	
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5. AUTHOR(\$) (First name, middle initial, last name)				
Tomas D. Bukale			,	
James P. Rybak			, i	
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TECH., OTHER	L. G. Hanscon			(LZ)
•	Bedford, Mass	achusett	в 01730	
13. ABSTRACT				
During entry into the earth's atmos				
vehicle, a plasma sheath envelops the ve				
ambient gases and ablation of the heat s				
causes the interruption of radio communi- ground based stations commonly referred				
blackout. To solve the blackout problem				
sheath properties (electron density, ele				
temperature and plasma stand-off distance				
causes and effects of the reentry plasma				
together with a discussion of reentry pl				
review of the flight experiments perform			•	
the reentry plasma.	- 			
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KEYWORDS: Reentry, Plasma sheath, Plasma diagnostics, Reentry vehicles

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ANTENNAS IN COMPRESSIBLE PLASMAS				
4 DESCRIPTIVE NOTES (Type of report and inclusive delea) Scientific. Interim.	•			
S Au "HORISI (Frest name, middle initial, last name) James P. Rybak				
6 REPORT DATE	TA TOTAL NO OF PASES	TA, NO OF REFS		
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TECH., OTHER		Research Laboratories (i.2)		
11 405'846'				
Measurements of antenna impedance are frequently used to determine the properties of plasmas which occur in the ionosphere and during the atmospheric reentry of space vehicles. An accurate understanding of the performance of antennas in plasmas is required for these purposes as well as for determining ways to minimize the reentry communications blackout problem. The results of the ionospheric rocket experiments have indicated the necessity, when analyzing antenna performance, of using a "warm" or "compressible" plasma theory which takes into a account the thermal motion of the plasma particles. The classical derivation of the hydrodynamic, compressible plasma theory equations is included in this report together with a discussion of appropriate boundary conditions. A review of the antenna analyses which have been performed using this compressible plasma theory is presented to illustrate the present "state of the art" of antenna-plasma analysis.				

KEYWORDS: Antennas, Antenna theory, Compressible plasmas, Plasma diagnostics

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Fort Collins, Colorado 80521		26. GROUP			
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MICROWAVE REENTRY PLASMA DIAGNOSTICS					
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James P. Rybak					
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TECH., OTHER	L. G. Hansco Bedford, Mas	m Field	search Laboratories (LZ) 01730		
13 ABSTRACT					
An analysis of surface-mounted aperture antenna admittance has been performed in this study to determine the conditions under which admittance measurements can be used for reentry plasma diagnostics. The primary contribution of the present work is the determination that the admittance of a thin, microwave aperture antenna, located on the surface of a reentry vehicle, can be used to obtain the values of the electron density, electron collision frequency, ion sheath thickness and electron temperature of the reentry plasma. It is further demonstrated, by using admittance measurements made during a reentry test flight as reported by Mayhan et al. (1968 IEEE Trans. Antennas and Propagation, AP-17, 573), popen-ended-waveguide antenna admittances can be used to determine the plasma electron density, electron collision frequency and plasma stand-off distance when the reentry plasma is separated, due to aerodynamic boundary layer effects, from the surface of the reentry vehicle.					
KEYWORDS: Reentry, Plasma sheath, P Reentry vehicles	lasma diagn	ostics, M	icrowave antennas,		

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SEISMICITY MAP OF THE ARCTIC COMPILED F EPICENTER DATA JANUARY 1961 THROUGH SEF	ROM ESSA, COAST TEMBER 1969	AND GE	ODETIC SURVEY,	
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James Dorman				
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Amer., Vol. 60, No. 5, pp.1741-1743,	Laborato L. G. Hanscom		w)	
1970. This research was supported by			s 01730	
13. ABSTRACT the Advanced Research Projects Bedford, Massachusetts 01730 Agency.				
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A seismicity map of the Arcti	c region north	of lati	tude 70°N	
containing 310 epicenters has been comp Coast and Geodetic Survey, for the inte	onted from data	tabulat	ea by ESSA,	
September 30, 1969. All of the hypocen	iters are less t	han 100	mougn km deen.	
The main feature is the continuation of	the Mid-Atlant	ic seis	mic belt	
through the Arctic, which follows a com	plicated patter	n of no	n-linear	
segments between Iceland and northern G	reenland and fo	llows a	remark-	
ably straight line across the Arctic Ba	sin between Gre	enland	and the	
Siberian shelf.				
KEYWORDS: Seismicity map of Arctic				
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Klaus H. Jacob					
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75, No. 32, November 10, 1970, pages	Laboratori				
6675-6689. This research was supported	L. G. Hanscom				
13. ABSTRACT by the Advanced Research	Bedford, Mass	achuset	ts 01730		
Projects Agency.			į		
			l l		

Recent seismological studies suggest lateral inhomogeneities in P and S velocities of the mantle that are associated with slabs of mobile lithosphere descending into the mantle beneath island arcs. In special cases, travel times of P traversing such zones can differ by as much as 5 sec and of S by up to 10 sec from standard travel times. In addition, such zones are characterised by relatively low attenuation of S-wave energy compared with high attenuation in a broad zone on the landward side of the active volcances. To explain the observed anomalous travel times and attenuation phenomena, it is necessary to trace the path of body waves through laterally heterogeneous earth models. The technique of ray tracing developed here uses Fermat's principle to obtain the differential equation of a ray in spherical coordinates. The position direction, and travel time of the seismic wave front at any point along the curved ray path are obtained by numerical integration of the differential equation for an assumed three-dimensional, continuous velocity distribution. The problem of representing a realistic three-dimensional velocity structure in the earth is solved in a way that is especially suitable for use on computers. Some examples for rays traversing an island-are structure are presented. The implications of this method of tracing rays in a laterally heterogeneous earth are discussed with respect to seismic travel-time studies, interpretation of residuals in terms of tectonic heterogeneities, source hias, and the precise location of earthquakes and nuclear explosions; dT/d2 measticements from large seismic arrays and their inversion to obtain d tails of the velocity structure in the upper mantle are also discussed.

KEYWORDS: Three dimensional seismic ray tracing, Heterogeneous spherical earth

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Jack Oliver			
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of the Earth and Planet. Interiors, V. 2, pages 350-362, 1970. This research was supported by Advanced Research Projects		Cambridge F ories (LW)	
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KEYWORDS: Mobile seismic belts, New (DD FORM 1473 (PAGE 1)	global tecton	ics Unclass	ified
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Redford, Massachusetts 01730		N/A	j	
NEPORT TITLE				
ROCKET-BORNE PHOTOMETER INVESTIGATION OF	NOCTILUCENT	CLOUDS		
4 DESCRIPTIVE NOTES (Type of report and inclusive dates)				
Scientific Final (1 June 1968 - 1 Febru	ary 1971; A	pproved 14	January 1971	
S AUTHOR(S) (Piret name, middle initial, last name)				
Leslie G. Smith				
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Bedford, Massachusetts 01730				
19. ABSTRACT				

The design, construction, testing and flight performance of a rocket-borne dual-photometer system for investigation of the aerosol particle distribution in a noctilucent cloud is described. One photometer is mounted with the axis of the field of view parallel to the spin axis of the rocket. This photometer is equipped with a polarizer and observes the degree of polarization of the cloud at a particular scattering angle and at a specified wavelength (3750Å). The second photometer is oriented at 60 degrees to the spin axis. The intensity of the scattered light is observed over a wide range of scattering angle at a wavelength of 5750Å.

KEYWORDS: Noctilucent clouds, Photometer, Rocket instrumentation

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Bedford, Massachusetts 01730 Electron production from the high temperature shock layer of blunt re-entry bodies are considered at high altitudes. The dissociation and subsequent ionization of air species due to the high flight speeds are predicted by analytical techniques with the consideration of the prevalent viscous effects at low density throughout the flow and with chemical relaxation of these species. The effect of vibrational nonequilibrium is also determined. Finally the spatial distributions of air species, temperature, velocity, and electron concentrations over a sphere-cone body, the Trailblazer, is mapped in detail for several altitude velocity conditions.				
KEYWORDS: Ionized bow, Viscous Electron density	shock lay	yer, Bo	undary layer,	

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3 REPORT TITLE		1		
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Ronald V. Book				
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Thomas Sugimoto				
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13. ABSTHACT				
An experimental investigation of a phomogeneous dissipative medium has bee diffusing a water solution of NaCl into a lawooden tank. The relative dielectric contangent could be varied from 0.13 to 3.0 at the investigation.	n made. Th arge block of stant was ap	ne medium of agar aga oproximate	was obtained by ar gel contained in a ely 78 while the loss	
Driving point admittances and curre medium inhomogeneity oriented parallel to input admittances were measured as a further in steps of 0.1). Symmetric and antisymeasured for four different antenna lengther measurement was repeated for three antenses Self and mutual driving-point admit separation (b/\lambda=0.25 to 1.5 in steps of 0.0.50, 0.75, and 1.0) with the medium inhantenna axes.	to the axes of the symmetric constitution of the symmetric constitution $(h/\lambda = 0)$. The second separation is the symmetry (125) for four somogeneity	of the ante antenna 1 urrent dis 25, 0.50, ions (b/\(\lambda\) measured antenna 1 direction	nnas. Self and mutual ength ($\beta h = 0.3$ to stributions were 0.75, and 1.0). Each 0.125, 0.25, and 0.50). d as a function of base lengths ($h/\lambda=0.25$, perpendicular to the	
Also studied were the effects of a n identical elements, and input aperture size				
KEYWORDS: Coupled linear antennas, Inho Driving-point admittances	omogeneous	dissipativ	e medium,	
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FINE STRUCTURE IN CAIL ON THE S	SOLAR DISC			
4. DESCRIPTIVE MOTES (Type of report and inclusive dates) Scientific, Interim				
5. AUTHOR(S) (First name, middle initial, last name)				
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84 CONTRACT OR GRANT NO. F19628-69-C-0077	94 ORIGINATOR'S RE	PORT NUM	BER(S)	
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(1970), pp. 202-215.	L. G. Hans			
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High-dispersion spectra of the core of the K line of CaII as seen at the center of the solar disc have been reduced. Resolution on the spectra approach l arc sec. Line profiles of individual elements are very asymmetric and often are peaked on only one side of the line center. Variations of the line profiles and the emission peaks are discussed. The doubly reversed mean profile of the K line is explained as a spatial average of individual profiles, and it is suggested that single peaks may be caused by Doppler-shifted discrete elements in the chromosphere.				
KEYWORDS: Solar disc, High-resolutio	on spectrogra	ms	·	
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	Components Division, East Fishkill Facility		
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Guenter H. Schwuttke			
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13 ABSTRACT	L	Massachusetts 01730	
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A short summary is presented of th	e major resu	lts obtained under	
Contract F 19628-68-C-0196. Refe	rence is made	e to the previous technical	
reports and scientific publications in which detailed discussion of the			
various phenomena is presented.			
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KEYWORDS: Defects in silicon,		ctor device performance,	
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Richard E. Kenyon				
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13. ABSTRACT				
This report review k acc	complished fro	m Feb	ruary 19 7 0	
through January 1971 on . desig	n, integratio	n and	launch support	
of various sounding rocket payloa	ıds. A sy <mark>n</mark> ops	is of	each payload	
states the basic experimental ob-	-		- •	

through January 1971 on . design, integration and launch support of various sounding rocket payloads. A synopsis of each payload states the basic experimental objectives of the payload; the support electronics and instrumentation supplied; and the results of launch support efforts. Additional material presents a versatile battery charger; a squib power monitor assembly; and the results of evaluation of magnetic detection techniques for motion and position monitoring.

KEYWORDS: Payloads, Rockets, Design, Sounding rockets

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Aerophysics Laboratory		26. GROUP		
Cambridge, Massachusetts 02139		<u> </u>		
3. REPORT TITLE				
ALLEVIATION OF THE PLASMA BOUNDARY	LAYER BY	CHEMICAL	INJECTION	
4. DESCRIPTIVE NOTES (Type of report and inclusive dates)				
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Charles W. Haldeman				
James P. McGuirk				
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Bedford, Massachusetts 01730				
Work performed during 1970 on the transmission and radiation				
characteristics of antennas on the surface of a plasma-covered wind				
tunnel model is reported. The model used is a blunted cone-cylinder				
operated in a supersonic wind tunnel at M = 4, T = 80 + 100°F and				
$P_0 = 1.2 + 3 \text{ psi.}$ The plasma sheath is obtained by injecting nitrogen				
plasma from a DC arc jet located in the model nose.				
A new chemical injection system was used to inject a number of				

halogenated hydrocarbons into the plasma layer through .0012 and .0006 inch diameter orifices at rates between .3 and 6 gm per minute (additive mass fractions from 5 to 100 percent). It was found that nearly complete restoration of free space antenna impedance and trans-

mitted power could be achieved from 25 mw S-Band signals at 50 percent or less additive mass fraction.

Data from electrostatic probes is presented which indicates that the mechanism of alleviation is electron attachment to form heavy negative species.

Teflon and carbon phenolic ablative plasmas were also studied and the effects of these ablative materials on the plasma sheath are presented.

The effect of ultrasonic energy on small fluid jets was also studied, as was the penetration of these jets into the wind stream. KEYWORDS: Plasma sheath, Microwave antenna, Plasma alleviation

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4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific Final. 1 August 1968-31 August	t 1970 a	pproved 13	October 1970	
5. AUTHORISI (First name, middle initial, last name)				
George J. Boer				
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This research was supported, in part, by the Air Force In-House Laboratory Independent Research Fund.	Laborato	ries (LKI)	e Research L.G. Hanscom Field etts 01730	
The measurement of small scale wind mot by means of the smoke trail method is described photographing the deformation of a trail of the analysis of four such trails deposit neously from different positions and which downward trajectories. The method of reduction of the photographic the smoke trails with time and subsequent the error in the resulting smoothed wind provided the wind profiles obtained by this expensivement which was made some 90 minutes lated the phase orientation and wavelength in the call shears. A temperature profile obtained in the made to relate the wind and temperature protheory. The results of gravity wave theory are be compatible with the theory although a contrastible.	ribed. This of smoke with ted by two reduced and the reduced and the reduced and the reduced and the reduced are the special profiles in the reduced and the reduced are the reduced and the reduced are the r	method obtaine. The cockets while trail on the cockets of the cock	tains wind motions by e experiment consists ch were fired simulta- both the upward and e position in space of d and an estimate of the an independent mea- critical wavelengths, istribution of verti- and an attempt is apple gravity wave surrements are shown to a of the motions is	
KEYWORDS: Winds in stratosphere and m	ne sosphere,	Smoke tra	il measurements	

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Ronald L. Cowperthwaite			
Howard Myers			
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13. ABSTRACT			
The dissociative attachment reaction I ions. The desirable characteristic cross section, (2) small value of the attachment, and (4) insensitive to the formed from stationary HI, these factors and is estimated to be 0.03 - 0.00 bombard a stationary light target mole and center-of-mass (CM) energy scales calibration. The reaction I + H ₂ - 10 electron affinity of H ₂ . For this case 64.5 and the energy spread in the CM is to be the order of one millivolt.	cs of the source H/I mass ratio, e electron beam e ors combine to gi ad results from t 6 eV, FWHM. By t ecule, a large di further improves	are: (3) no energy live an the the using liftered energy	(1) large attachment early thermoneutral spread. When I energy spread of ermal motion of the heavy I ion to nce in laboratory ev resolution and
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Solid State Spectroscopy Laboratory Physics Department, Northeastern University Boston, Mass. 02115		Unclassified	
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THE STUDY OF THE REFLECTIVITY OF INORGANIC MATERIALS IMPORTANT FOR REMOTE SENSING APPLICATIONS			
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Clive H. Perry Robert P. Lowndes			
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L.G. Hanscom Field Bedford, Mass, 01730			
The influence of phase angle, compacts total reflectivity in the frequency range materials is presented. The determination of the k ≈ 0 longits the dielectric and inverse dielectric responsive total reflectric and inverse dielectric responsive to the dielectric and inverse dielectric responsive to the temperature k ≈ 0 LO frequencies and lifetimes of 18 and determined from Kramers-Kronig analyses of reflectance data and from small grazing and conducting substrates. In addition, the proposition of the LO frequencies of RbI, CsBr and Far infrared transmittance and reflect normal incidence and Raman spectroscopic metalline thallous iodide in the temperature and calcite single crystals are present a function of particle size, packing fraction of quartz and calcite single crystals are present and calcite. Infrared and Raman measurements of a state of the interpretation of remote sensing data and their characteristic lattice and Christians to the interpretation of remote sensing data and a discussion of the of Er³+ in the rare earth fluorides is given bands in some low temperature stars is also KEYWORDS: Infrared, Raman, Remote sensing the proposed to the interpretation of the same proposed to the propo	udinal opticonse function dependence of lkali and the near normal gle reflectaressure dependence of the consensurements as a function spectroseasurements as a function and phase number of min son frequence of the consensurements as a function and phase of the consensurements as a function and phase of the consensurements are the consensurements as a function frequence of the consensurements are the consensurements are the consensurements are far infrarece of the consensurements are	frequencins of simpover the rallium halincidence data for the reported. Scopic measure reported to the angle for t	riety of inorganic es and lifetimes from le cubic solids is ange 5-400°K of the ides are given as single-crystal rom thin films on to 5 kilobars at surements at near ed for poly- hase angle for fused he reflectivities as r powdered samples used to determine e directly applicable d Zeeman splittings
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Scientific, Final 1 October 1967 to 30) September l	970 Appr	oved Jan. 15, 1971
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The investigations carried out under the terms of this contract consist of an attempt to find unique applications for the SCAD-Small Current Amplifying Device -, a new semiconductor device and the design of low noise preamplifiers suitable for new solid state sensors, a study of electrolumenescence in Ge and a study of the anomalous behavior of Schottky

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	Bedford, Ma	ssachusetts 01730		
This final report gives a summary of the principal topics of study and the main accomplishments of Contract No. F19628-68-C-0188. It also contains a complete list of publications issued under the contract and some specific recommendations for extension of the work.				
KEYWORDS: Radiation effects, Electron slowing down, Secondary electron emission, Radiation dosimetry DD, FORM NOV 85 1473				

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13 AUSTRACT	Bedford, Massachusetts 01730
The report gives a survey of work on the gels and the various factors which influe structure. It shows how both factors cathe use of so-called hybrid growth systeknown as "gel gettering". The report alret mixtion processes, their problem II is call role of cusps in controlling concludes that the method is inherently omakes three proposals for future resear	nce it: heterogeneous nuclei and gel n in principle be controlled, through ms and a recently devised process so describes research on seeding and as and potentialities, and discusses rystal growth in the gel medium.
REYWORDS: Crystal growth, Gels; gelling	process; Nucleation, Diffusion Unclassified
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13. ABSTRACT				
Electrostriction is a cause of laser beam siglass. It predominates over other self-focor thermal self-focusing, under certain conself-focusing can occur even if the laser prise achieved, provided the pulse power is lathreshold power for self-focusing is independent, the threshold power increases and initial beam radius, in the limit of large ratheoretical trapping threshold derived here thresholds for track formation in glass.	using mechanis nditions. This alse is so short arge enough. In andent of beam s becomes propo- adius beams or	ms, su paper s that no the ste ize. In tional short p	ch as Kerr effect shows that steady state ady state, the n the transient to the square of the ulses. The	
KEYWORDS: Laser, Electrostriction, Sel	f-focusing, Glas	ss dam:	age	
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Planar structures were operate while Si:SiO ₂ structures had e currents as large as 0.6 mA we densities in excess of 100 mA/also operated continuously, an amperes could be drawn for sevfrom the viewpoint of practica	cold cathodes is discussed, an		
KEYWORDS: Electron emission, Cold ca	chades Photoemission		
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The analysis and the design of the elements of a large array of circular apertures on a triangular grid is approached by modeling the antenna as an infinite structure rotationally symmetric and periodic along the cylinder axis. Because of this particular symmetry every possible excitation is the superposition, with suitable weights, of a set of fundamental excitations having uniform magnitude and linear phase progression in the azimuthal direction and in the direction of the cylinder axis ("eigenexcitations"). Thus, by invoking superposition the electromagnetic analysis of the array is reduced to the solutions of the simpler boundary value problems pertinent to the set of eigenexcitations. This is done by expanding the field in normal modes in the region exterior to the cylinder and in the waveguides feeding the apertures, followed by a field matching at the cylinder surface (obtained approximately through Galerkin's method). The realized gain pattern of the radiators can be modified to a considerable extent by using an "element pattern shaping network" (in the radiator waveguides), serving the purpose of matching the array for a selected eigenexcitation. Criteria for the network design are given. A series of numerical examples illustrates the technique and shows that a "flat" element pattern can be thus obtained with a gain fall off with respect to the peak of less than 6 db at 80 degrees.

KEYWORDS: Conformal arrays, Element pattern design, Wide angle coverage

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of 10 ⁻⁵ and 10 ⁻² torr have been investigated as a function of the energy trans-			
ferred to the acetylene molecule during the initial ionization by charge exchange			
with incident positive ions of low kinet	-		-
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molecular ion in an excited electronic	otate (a -1) The		on hose of the
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are elucidated, and numerous reaction	-		
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This report ?iscusses the problems of logic design by means of finite field theory their interrelationship and some approaches to their solution, with emphasis on logic networks whose function is externally determined. Galois theory is the study of finite fields and can be viewed as a generalization of the two-element Boolean algebra traditionally used in logic design. As a mathematical foundation for logic design, Galois theory offers far greater flexibility in the choice of basic primitive logic gates, an arbitrarily great increase in economy of thought and the possibility of choosing a mathematical structure which is best suited to each stage of technological development. Various basic decisions are made with regard to field size, Boolean encoding of field elements and primitives for the context of design; actual logic design is then carried out in the familiar language of polynomials. Reasoning processes are identical to those of elementary algebra with further simplification frequently possible. This report attempts to give an introduction to those topics of Galois field theory most relevant to hardware vendor and logic designer and develops the theory of universal Galois functions and its categorical implications. There is a detailed discussion of Boolean encoding procedures which lead to highly efficient Galois multiplication gates and optimal Galois addition gates. Various single-primitive systems are considered, capable of utilizing a single LSI chip-type throughout any network to be designed. One especially natural primitive offers the additional potential of maximizing effective LSI-yield. Methods are suggested for the design of general and universal Galois functions in two-primitive and one-primitive systems. In conclusion, a variety of areas is identified for further research in Galois logic design. KEYWORDS: MSI/LSI, Logic Design, Cellular arrays, Finite fields			

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IS ABSTRACT			
An experimental pulsed neodymlum lidar system was modified as	nd calibrated to obt	dn accurate data	on atmospheric extinction

An experimental pulsed neodymlum lidar system was modified and calibrated to obtain accurate data on atmospheric extinction properties in fog and low cloud conditions. The objective was to establish the theoretical and practical basis of a system for measuring slant visibility conditions for aircraft landing operations. To operate in conditions of fog and low cloud the lidar system's dynamic range was extended to 50 dB by using a two-stage receiver system. In addition, the transmitter and receiver beams were made coaxial to make close-range observations.

Field trials were carried out at a temporary site at Half Moon Bay, California, and at the National Bureau of Standards site at Arcata, California, in May/June and August 1970, respectively. At Arcata, data were collected in conjunction with measurements by an array of up to five AN/GMQ-10 transmissometers. Observations were made in clear weather and in conditions of fog and low cloud using arrays of passive targets to provide information on atmospheric extinction. The correlation between atmospheric transmittance derived from lidar/target data and from AN/GMQ-10 transmissometers equalled that found between the data from individual transmissometers. Thus, a lidar with the support of passive targets could replace a transmissometer system with comparable accuracy in determining atmospheric transmittance.

Single-ended lidar data were obtained along horizontal paths adjacent to the passive targets and to a 500-ft base line transmissometer. Atmospheric transmittances were computed from these lidar data using analytical methods (which are discussed in detail) of evaluating atmospheric extinction coefficients from a consideration of the "slope" of the lidar trace. A correlation coefficient of 0.97 was found between the lidar data and the transmissometer data for comparable path transmittances in a variety of low-visibility conditions.

The concept of remotely deriving extinction coefficients aloft from observations by a ground-based lidar was applied to the aircraft landing problem. Using values of extinction coefficient for atmospheric layers above the surface derived from series of lidar observations at different angles of elevation, examples are given of the calculation of transmittance over the line-of-sight path from which a pilot would look (at a cockpit out-off angle) from the critical height to the surface to acquire visual reference. No corroboration of these evaluations of slant path transmittance was available. Possible means of deriving and presenting such data for operational purposes are outlined, and the potential use of lidar for revealing the general conditions of cloud and fog conditions in the airfield approach are described.

The problem of realizing an operational system in an ultimate form is considered and some potential approaches to this end are noted.

KEYWORDS: Lidar measurements of visibility, Lidar measurements of atmospheric transmittance

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The effects of atmospheric i	rregularities on line-of-sight propagation
are studied both experimentally an	d theoretically. The experimental measure-
ments utilize a pair of 35 GHz tra	insmitting antennas, time shared through a
rapid switching arrangement, and a	n array of receiving antennas at each of
which amplitude and relative phase	of the arriving wave are measured
senarately This configuration is	coordinated with 11 GHz transmissions
propagated over the came 22 km nat	h. The entire set-up is highly versatile
propagated over the same 20 km pat	types of propagation measurements to be
	. Cyping of propagation measurements to se
made in near simultaneity.	
Among the types of measureme	ents made are some aimed at inferring the
extent of atmospheric innomogenet	oution along the nath and the cross-nath
structure constant $C_{\overline{n}}$, its distrib	oution along the path, and the cross-path
wind. Measured data are combined	with specific applications of the theory
to achieve these aims.	
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The resultant is applied to the problem of weights projective plane of order 10 (if it exists) is examined the special case of the (48, 24) binary extended (60, 30) ternary extended quadratic residue code is sults include study of the question whether Steine	uadratic residue coue is worked out in detail. The is proved to yield new 5-designs. Miscellaneous re-	
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A theory of characteristic modes for from the operator formulation for the corthogonal set over the conductor surface set over the sphere of infinity. It is introduced by Garbacz to diagonalize the for the use of these modes in antenna a cedure for computing the characteristic developed, and applied o conducting be Illustrative examples of the computation	current. The mode cuace, and the mode fies shown that the mode is scattering matrix and scatterer problems modes for bodies of podies of characteristic	errents form a weighted elds form an orthogonal es are the same ones of the body. Formulas as are given. A programming the same is and to wire objects. currents and char-
acteristic fields are given for a cone- solutions using these modes are compute problems to illustrate convergence of t increased. For electrically small and	ed for representative the solution as the n	e antenna and scattering number of modes is

KEYWORDS: Bodies of revolution, Characteristic currents, Characteristic fields

are needed to characterize the electromagnetic behavior of the body.

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13. ABSTRACT			
Computer programs are given for and characteristic gain patterns of cor are computer programs for using these cation and plane-wave scattering problem plotter are included. Operating process and sample input-output data are given.	ducting bodi haracteristi is. Plot pro lures and pro	es of revolu c currents i grams for us	ition. Also given n aperture radi- e with a Calcomp
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A large number of numerical and exper a variation of the antenna parameters on the antenna are presented. These results may antennas.	e radiation prope	erties of a short-backfire	
The numerical results have been calcul previously published theory for backfire an mental results have been measured in a ra	itennas with dipol	e elements. The experi-	
Other numerical results have been obtained, which show that the radiation properties of the short-backfire antenna correspond to those of open resonators. Finally, a number of computations have been carried out in order to investigate the possibility of applying the short-backfire antenna as the excitation system of a Yagi antenna.			
KEYWORDS: Dipole structure, Backfire an Short-backfire	tenna, Paramete:	r variation,	
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In order to make possible a rigoro	us program of research and development
of high energy battery systems based on a	protic organic electrolytes and lithium
anodes, a literature survey and a number	of experimental studies have been con-
ducted on the purification and analysis of a	elevant solvents: acetonitrile, butyro-

In order to make possible a rigorous program of research and development of high energy battery systems based on aprotic organic electrolytes and lithium anodes, a literature survey and a number of experimental studies have been conducted on the purification and analysis of relevant solvents: acetonitrile, butyrolactone, dimethyl sulfoxide, dimethyl formamide, formamide, hexamethyl phosphoramide, N-methyl pyrrolidone, propylene carbonate, and tetrahydrofuran. In all cases, methods have been developed (where not already available) for purification to a level of less than 10 ppm water or organic impurities, and for analysis of the solvents at that purity level. Purification methods employed include vacuum fractional distillation, dehydration with molecular sieves, chemical reaction to remove specific impurities, and preparative gas chromatography. Analytical methods include gas chromatography, ultraviolet and infrared spectroscopy, condetance, polarography, and solid electrode voltammetry. Stability of the pure solvents, particularly in contact with lithium electrodes, has been examined critically. For the solvents propylene carbonate, dimethyl sulfoxide, dimethyl formamide, and hexamethyl phosphoramide, the exchange current of a solid lithium electrode has been determined and the effect of added water on this kinetic parameter has been studied.

KEYWORDS: Nonaqueous solvents, High energy batteries, Lithium electrode

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13. ABSTRACT Neutral temperatures have been	measured above 120 km altitude from			
observations of the fluorescent emission of	aluminium oxide and barium oxide clouds			
	GE, Kiruna. The temperature observations			
showed a strong correlation with the C9 da				
the 3-hour Kp index, expressed approxima				
twilight for 140 and 165 km altitude (averag				
T(140) = 420 + 25	x C9 (^o K)			
T(165) = 450 + 50	x C9 (^o K)			
A small diurnal variation appeared from the	e data, the temperature at 165 km being			
n average 100 K higher during evening twil	ight than morning twilight. No clear			
seasonal or longer term variations were a				
indicate a strong auroral zone enhanceme	nt of the heating associated with			
geomagnetic activity.				
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KEYWORDS: Ionosphere, lonospheric tem	peratures, ionospheric probe			
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DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific Interim,			
5. At : H(S) (First name, middle initial, last name)			
David Rees			
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KEYWORDS: Ionosphere, Ionospheric winds	L.G. Hanscom		
Ionospheric probe 13. ABSTRACT Observations of the drift velocit	Dediord, Mass		
been used to determine neutral wind velocity and ion velocity in the altitude range 90-230 km at ESRANGE, Kiruna. The ion cloud drift measurements have demonstrated the orthogonality of the simultaneous magnetic perturbation vector at ground level and the ion drift vector in the F region of the ionosphere. This result implies that in the auroral zone Hall currents are predominantly responsible for that part of the total magnetic perturbation seen at ground level due to ionospheric currents. A comparison of neutral wind velocity profiles obtained under quiet and disturbed geomagnetic conditions has shown that in the auroral zone the observed west-east neutral wind component above about 120 km altitude is directly correlated with the mean south north magnetic perturbation vector over a period of two-three hours prior to the observations. This correlation is due to acceleration of the neutral atmosphere above			
120 km by ions drifting in a meridional electurbation and the neutra¹ acceleration are electric field and of the electron (and hence bance of 200% of three hours duration, a new observed near 150 km altitude. In general, wind speed (V _{NV} , m/s) following disturbed to ∆X, the two-hour mean of the south-nor (from a quiet ionospheric level), by V _{NV} disturbance a produce westward winds and auroral zone may be related to the anomal observed at times about 120 km altitude at	ctric field. Both direct functions of ion) density. As entral wind veloc in the auroral zell conditions has the magnetometer 2.5 \(\) \(the graph of the fiter a city of one the peen for disturns e is the dist	cound magnetic per- locally enhanced positive bay distur- nearly 500 m/s was e west-east neutral ound to be related rbance in gammas s such that positive urbances in the
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Investigation of Spectral and Statistical	Properties	of Single-	Mode CW Lasers.
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Variance and power spectrum	of intensity	fluctuation	ns of a single

Variance and power spectrum of intensity fluctuations of a single mode CW CO₂ 10.6 micron gas laser have been measured by using a copper-doped Germaniun detector and analog instrumentation. RMS intensity fluctuations above the oscillation threshold was smaller than 0.3% of the average intensity. The measurements near the oscillation threshold, however, were not accurate, because the acoustic disturbance due to acoustical noise, bubbles in the cooling water and temperature fluctuations in the plasma tube were predominant over the fluctuations due to spontaneous emission. The power spectrum observed at frequencies above 10KHz showed features characteristic to the laser model of Van der Pol oscillator driven by the random noise. Improvements of CO₂ gas laser desirable for further investigation are discussed.

KEYWORDS: CO2 gas laser, CW single mode laser, Intensity flucuations

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			ssachusetts	01730
13. ABSTRACT This report is divided into three	parts			
(1) The presence of large scale to in the ionosphere may be treated !	ume-dependent	dynam.	ic disturban	c e
integral equation with Green's fur	nction satisf	nnomogo ving h	eneous linea Omogeneous	r
boundary conditions. For the spec	cial case when	re the	re īs no dis	-
turbance, the theory reduces to the	he wall known	resul	ts for a qui	et
' ionosphere.				
(2) The disturbance of the ionosph	nere by a long	g perio	od travellin	g
wave originating in the northern h	nemisphere ha:	s been	detected in	the
southern hemisphere with the accome the wave crosses the magnetic equality.	mpanying expe	cted p	hase change	as
(3) A comprehensive survey has been	en made into	the qu	estion of	
anomalous sounds from auroras. Protection that the theory of brush discharge	reliminary re	sults :	seem to show	oh-
served phenomena without inconsist	tency.	, expr	GAL CHE	~ <i>U</i> =
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5. AUTHOR(S) (First name, middle initial, last name)				
Sidney R. Smith				
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į	Bedford, Massachuset	ts 01730		
13. ABSTRACT I. Several methods for the analysis of th	<u></u>			
from hydrocarbon pyrolysis are examined. The metho	od of sample combustion is	s an oxygen atmosphere and		
analysis of the hydrogen content by mass spectrometry				
series of replicate runs with a standard deviation 3.5%	on samples in the 1.5-8 m	gm range.		
II. The pyrolysis of naphthalene has been studied by the				
products show that there is no splitting of the C-C bo the products of the reaction. The naphthalene polyme				
chromatographic methods.	ers are characterized by the	199 sheertottieret wird Rws		
The rate constant for hydrogen formation in the initia	I stages of the nurolysis ca	n he expressed by		
		0-700°C. The kinetics data		
and reaction products can be explained by either a bin	golecular or free-radical p	redominantly homogeneous		
reaction mechanism.	•	. •		
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KEYWORDS: Carbonaceous material, Carbon hydrogen analysis, Mass spectrometry, Gas chromatography, Pyrolysis of nephthalene

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Hawaii Institute of Geophysi	C S ZA. GROUP
Honolulu, Hawaii 96822	
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THE MEAN TROPOSPHERIC CIRCUL	ATION AND CLOUDINESS
OVER SOUTHEAST ASIA AND NEIG	
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James C. Sadler	
Barry E. Harris Lt. Col. U	SAF
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,	L.G. Hanscom Field, Bedford
12. ABSTRACT	Massachusetts 01730

Mean monthly wind analyses for the 3,000 ft, 850 mb, 700 mb, 500 mb, 300 mb, and 200 mb levels are discussed in terms of major features and their change from month to month. The mean monthly cloudiness, compiled from five years of daily meteorological satellite data, and the change in mean cloudiness from month to month are related to the flow patterns and their changes. Longitudinal sections of monthly cloudiness and month-to-month changes in cloudiness are presented for eight selected longitudes between 70E and 140E.

KEYWORDS: Southeast Asia, India, Burma, Philippines

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Honolulu, Hawaii 96822			
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4. DESCRIPTIVE HOTES (Type of report and inclusive dates)			
Scientific. Final: 1 April 1965 to 30	September 1970	. Appı	roved: 16 Movember 1970
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Frederick M. Matsunaga			
Kenichi Watanabe			
William Pong (PI)	Tan 200		
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13. ABSTRACT			
Measurements of spectral absorption a	nd photoionizati	or cro	ss_sections of CO2,
NH3, 02, COS, NO, N2, and vinyl chloride i	n the region 580) - 165	O A were made.
A number of new Ryiberg series were found	and the converge	ence 11	mira were combared
with the photoionization values. In the study of dispersed rluorescence	e from molecules		foules attention use
given to the emissions from CO, NH ₂ , N ₂ , a			
6000 A. The experimental Franck-Condon fa	ctors for CO and	I.M. ve	re found to be in
good agreement with the theoretical values	. The threshold	l for t	he NH $c^1\Pi \rightarrow a^1\Delta$
transition was observed at (1245 * 10) A.	On the basis of	the o	bserved threshold of
the NH emission, the calculated energy sep	aration of the	ı¹∆ sta	te from the ground
state of NH is (2.2 * 0.1) eV which is som	ewhat higher the	in the	value previously
reported. The excitation spectra of NO sh	ow many overlap	ing st	ates. However, the
$B' \longrightarrow X$ transitions of NO were identified,			
factors are in agreement with the calculat	ed values. The	result	s suggest that the
y' band contribution in NO emission is neg	ligible. The ex	ccitati	on spectra of other
molecules such as H ₂ , O ₂ , and SO ₂ were stu		n rest	wres of the emission
spectra can be related to the spectral abs The effect of molecular collisions on	orpulon. the fluorescen	e of W	O was investigated
Quenching of the B', D. E, and F states vi	th the 'nhancem	ent of	the y band emission
was observed.			
KEYWORDS: Absorption coefficients, F	Photoionization	vield	5

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Urbana, Illinois 61801			••
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No. 3, pp 801-803, 1970	L.G. Hans		
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13. ABSTRACT			• • • • • • • • • • • • • • • • • • • •
Ion drag is one of the dominant forces which thermosphere. As a result, the neutral will electric field. Improved agreement betwee experimental data has been obtained by incomputed meridional wind occurs at the sa	inds are modifi n theoretical w luding the effect hat the reversa	ed bythe rind velo cts of the	e presence of ar ocities and le dynamo field. Com theoretically
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gets by fast heavy particle in	radiatio	n. The	major portion	l	
of the work involved proton in	radiatio	n of so	olids using ene	гву	
ranges from 0.7 to 2.5 MeV. A	lpha par	ticles	and deuterons	ļ	
were also available and were userneral, the results of the bo	ised for Imbardmen	special	l studies. In	Į	
ther electron spin resonance	[ESR] or	differ	rential thermal	n I	
rhermal analysis [DTA] techniq	ues.				
The data provided by the ES	R analyt	ical me	thods tends to		
substantiate the conclusion that proton bombardment of dia- mond results in the formation of CH radicals. Furthermore.					
there is no doubt that H atoms can be trapped in the dia.					
nond lattice and Will remain u	ncombine	d at li	quid nitrogen	1	
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KEYWORDS: Radiation damage, D	iamonds,	Protons	3		
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4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific Interim				
5. AUTHOR(S) (First name, middle initial, last name)				
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1970, Vol. 3, pp 789-796	Laboratorie			
	L.G. Hanscon			
İ	Bedford, Mas	sachus	etts 01730	
13. ADSTRACT	<u> </u>			
Townsend's primary and secondary ionizate 0.003, 0.03, 0.03 and 3% of n-pentane, ethy total pressure in the range of 0.5 to 5.03 to For n-pentane, a concentration of 15% was effect is again observed and is greatest in enhancement of Townsend's primary ionizathat previously observed in the classical rabons are observed to be efficient quenching the less efficient. At an optimum concentr sparking voltage is lowered considerably be being the most—and amounting to a factor acetylene mixtures.	rlene and acetyler and for a unitalso employed, about 0.1% of action coefficient agents, acetyleation of 0.03% felow that for pu	form fi A ma etylene in this s. As ene in t for all re arge	xed in argon for a eld gap up to 1 cm. rked Penning in argon; the mixture exceeds usual, the hydrocar- this respect being the mixtures the on, the lowering	

KEYWORDS: Measurement of Townsend's primary and secondary ionization coefficients. Hydrocarbon-argon mixtures, Penning effect

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4. DESCRIPTIVE NOTES (Type of report and inclusive dates)				
Scientific Interim				
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12, December 1969, pp 2101-2104	L. G. Hanse	_ :		
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13. ABSTRACT				
The influence on the prebreakdown process				
gas moving at an angle to an electric field a				
ered quantitatively by invoking the equivalent				
which a moving gas displaces the charged p	articles taking	part in	the processes	
leading to a spark is found, and the variation				
is calculated. With a pure cross gas flow, predicted, and this is in agreement with ex	no change in th	e elect	ric strength is	
have been attained. With axial gas flow, th	e moving gas c	c gas s an eithe	peeds up to 2 X to III/	
decrease the gap strength depending on the				
field due to the direct applied voltage, and				
magnitude with the electron drift velocity (
strength always occurs). A novel method fo				
and hence the electron-molecule-collision f				
evolved. The analogy between a moving ga	s and an applied	cross	ed magnetic field	
is pointed out. This leads to a second meth				
simultaneous application of a moving gas ar				
relevance to compressed-air-blast circuit	breakers is con	sidered	i .	
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KEYWORDS: Theory prebreakdown, Proces	sses and sparki	ng, Vol	Itage of a moving gas	
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A REPORT TITLE GASEOUS TOWNSEND DISCHARGES IN GAS MIXTURES, IN A CROSSED MAGNETIC FIELD AND IN A MOVING GAS						
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific Final, 1 October 1969 - 30	September 197	70.				
5. AUTHOR(S) (First name, middle initial, last name) A. E. D. Heylen M. P. Watts		·····				
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13. ABSTRACT						
The final results of a three-part experi	mental and the	awetical	wasaawah nuaguan			
on gaseous Townsend discharge are con influence on the prebreakdown processe moving at an angle to an electric field a sidered quantitatively by invoking the exwith which a moving gas displaces the oprocesses leading to a spark is found, a with gas flow was calculated.	tained in this r s and the spark cross a uniform quivalent press harged particle and the variatio	eport. cing voluing streamly streamle con es takin on of the	Firstly, the tage of a gas essed gap was concept. The velocity g part in the gap strength			
Secondly, Townsend's primary and secondary ionization coefficients have been measured in .003, .03, and 3% n-pentane, ethylene and acetylene mixed in argon for a total pressure in the range 0.5 to 500 Torr and for a uniform field gap up to 1 cm. For n-pentane, a concentration of 15% was also employed.						
Thirdly, further work on the dynamic Townsend discharge in a crossed magnetic field is presented. This work includes both experimental and theoretical results on pulsed discharge propagation and measurement of the E/P and other avalanche parameters using the balanced pulse technique.						
KEYWORDS: Townsend's primary and sec Sparking voltage, Argon-hyd						

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TECH, OTHER	Laboratories (LY) L. G. Hanscom Field					
	i					
13. ABSTRACT	Bedford, Massachusetts 01730					

A simple, four-level primitive-equation model of a zonallysymmetric tropical atmosphere has been combined with a two-layer model of the upper tropical ocean in order to predict three years of inter-tropical convergence zone (ITCZ) behavior under the influence of seasonally-variable solar heating of the sea. A cold equatorial surface develops on account of oceanic upwelling and vertical mixing; a single ITCZ establishes itself, cff the equator, over the surface temperature maximum in the warmer hemisphere. This convergence zone migrates quickly between hemispheres, with only a minor lag, when the progress of the seasons causes the hemispheric surface temperature asymmetry to reverse every half year. Such behavior is qualitatively in accord with that of the updraft branch of the mean tropical Hadley circulation in the real atmosphere. The lag of maximum sub-equatorial sea surface temperature behind the overhead sun of late summer is computed to be about nine weeks, a reasonable value.

KEYWORDS: Numerical model, Seasonal variations, Tropical atmosphere

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Giuseppe Occhialini				
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13. ABSTPACT	L			
A high energy neutron detector has been flux, under quiet or active Sun conditions. The detector consists of a plastic scintillat dence shield. The central detector is surrepurpose is to bring to rest the recoil protor effects and keeping the detection efficiency flux has been however detected and an upper established for the continuous flux, which is with other upper limits, obtained over the sampler limit of 30 n/cm is established for commidirectional intensity of atmospheric gasheath, has been measured at balloon altitudes 33/cm sec has been found for energies good agreement with those obtained by Fich	over the energy or (the central dounded by an alune, thus diminish high enough at her limit 5, 5 x 10 s comparable (al ane energy rang a lN importance amma rays, convertes at three energy reater than 20 h	range 10 etector) minium ning the igh ener n/cm though e. A ti optical erted in rgy leve MeV. Ti	O MeV to 200 MeV. with anticoincisheath, whose "self-gating" rgies. No finite sec has been somewhat lower) me integrated flare. Also the the aluminium els. A value of	
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AN INTERFEROMETER SYSTEM FOR THE MEASUREMENT OF THE AZIMUTH OF RADAR ECHOES FROM METEOR TRAILS		
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Ronald R. Rudman Filson	H. Glanz R. Clark	
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To improve the measurement of the azimuth direction of arrival of radar echoes at 36.8 MHz a digitally controlled phase sequence interferometer technique has been developed for incorporation into the UNH/AFCRL meteor trails radar system. Phase measurements are made with respect to a common calibration pulse inserted between successive echoes. Preliminary tests indicate an azimuth measurement capability of better than ± 2° when used in conjunction with an elevation measurement system of comparable accuracy.

KEYWORDS: Meteor trails, Interferometer, Meteor radar,
Digital switching, Direction finding

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IS. ABSTRACT	A A AND THE STATE OF THE STATE	

This report is a description of the UNH Meteor Trails Radar Main Off-Line Computer Program. The report consists of a summary of the program and a complete listing and flowgraph of the program. The main contribution is the method of determining azimuth and elevation angles from the UNH/AFCRL Meteor Trails Interferometric azimuth-elevation system.

KEYWORDS: Meteor trails radar, Upper atmosphere winds, Interferometer direction finder, Data processing

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Scientific Interim s. AUTHOR(S) (First name, middle initial, last name) Lyman O. Williams			
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TECH, OTHER KEYWORDS: Remote sensors, Water, Vegetation, Soil, Rock, Topography 13. ABSTRACTISOPLETH mapping, computation of	Air Force Cambri Laboratories (I L. G. Hanscom Fi Bedford, Massach	dge Research LW) ield uusetts 01730	
multiple linear regression analysis have be			

vegetation-soil-rock-topography in a 50 mile long, 12 mile wide area centered on Ashe ville, North Carolina. Comparison of data suggests that analysis of the 100 random samples give results which are comparible to isopleth mapping of 196 sample sites for variables which have relative abundance and which have relatively contrasting properties of weathering, erodability and water retention. These variables are clay and silt in soils, quarts in soils, potassium feldspar in soils and bedrock, garnet in soils, biotite in both soils and bedrock, and muscovite in bedrock, and they appear to be dependent on a unique combination of independent variables. Accordingly it appears that lowlands (Case A) will be more likely to have clay rich soils, with relatively longer channel lengths per square mile, and to have soils which have low color values and relatively more soil moisture. The subsurface is likely to have abundant muscovit or biotite in both soils and bedrock, and garnet will be associated. Quartz will probably be essentially absent in the shallow subsurface. Conversely uplands (Case B) will probably have abundant silt and sand in soils, have shorter channel lengths per square mile, and have soils which have high color values and lov soil moisture contents. The subsurface will probably have moderate to abundant quartz, and relatively great proportions of potassium feldspar. It appears that different steady states exist for these two different bedrock conditions. The flow of matter and energy in the system implies that surface phenomena will evolve in response to each condition of bedrock so as to develop a unique combination of topography, water and vegetation conditions. graphic conditions, then a catalog could be developed which would allow useful interences to be made from measurements of surface phenomena on remote sensor images.

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This research was partially supported by the Defense Atomic Support Agency.	Air Force Cambridge Research Laboratories(LI L. G. Hanacom Field Bedford, Massachusetts 01730		
13. ABSTRACT			
Two Aerobee rockets, instrumented parameters, were launched from the Chu Canada in late March 1969. Ejected no utilized to obtain simultaneous measur the aurora. The instrumentation inclu electron density and temperature probe photometers. Details of instrumentation	setip payloads and main payloads were ements at separate locations within ded electron and proton counters, s, X-ray counters and auroral light		
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KEYWORDS: Auroral measurements, Rocket instrumentation, Ionospheric measurements, Instruments for auroral measurements

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TEMPORAL FREQUENCY SPECTRA OF MULTIFREQUEN	CY WAVES IN	A TURBULEN	T ATMOSPHERE	
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Akira Ishimaru				
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-	Bedford, Ma	ssachusett	s 01730	
IS. ABSTRACT				

General formulations for temporal frequency spectra of the fluctuations of plane, spherical and beam waves operating at two frequencies are given based on weak turbulence and frozen-in assumptions. The cross spectra and the coherence are obtained for the amplitude at two frequencies, the phase at two frequencies, and the amplitude at one frequency and the phase at another frequency. The results are examined in detail for a plane wave case. For the spectrum of the index of refraction κ^{-B} in the inertial subrange, the amplitude spectrum behaves as $k^{(5-n)/2}$ for $\omega + 0$ and $k^2\omega^{1-B}$ for $\omega + \infty$. The phase spectrum for $\omega + 0$ and for $\omega + \infty$ behaves as $k^2\omega^{1-B}$ with different constants. These results agree well with the experimental work of Janes, Thompson, Smith, and Kirkpatrick at 9.6 GHz and 34.5 GHz, and explains the ratio of the spectra at two frequencies. Also noted is the experimental slope of -2.6 as $\omega + \infty$ which may be compared with 1 - n = -2.66 using the Kolmogorov spectrum of n = 11/3. The amplitude and phase coherence are calculated and the results agree well with the experimental data. This agreement is indicative of the general validity of the theory for frequencies as low as 10 - 30 GHz and the path length as long as 60 km. It is also shown that using the above theory, the wind velocity and the structure constant C_n can be deduced from the experimental data.

KEYWORDS: Temporal frequency spectra, Multifrequency waves, Turbulent atmosphere, Fluctuations

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Box 44, Princeton, New Jerse	y 08540			
NEW CHARGED PARTICLE DETECTORS				
Scientific Final. 1 Nov.1966 - 1 Jan. 1970 31 Aug. 197				
Victor J. Belanger				
17 March 1970	74 74 75 NO. OF PAGES 78. NO. OF REFS			
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TECH, OTHER	Air Force Cambridge Research Laboratories (CRF) L.G. Hanscom Field L.G. Massachusetts 01730			
The objectives of this program were to perform experimental investigations directed toward the design and fabrication of new charged particle detectors. The particle detectors are to be used in satellite, rocket, and laboratory experiments to study the magnetospheric boundary regions of space and must be capable of detecting particles with energies of 1 keV or less maintaining high counting efficiency. To attain these goals it was necessary to do extensive field plotting of entry dynode structures in order to arrive at a design configuration that would insure good collection and counting efficiencies, also it was necessary to devise equipment, fixturing, and testing techniques for accurately determining spatially, these efficiencies.				
KEYWORDS: Experimental investigations, Design, Fabrication, Particle				
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Index

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 No. 341.
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- AFCRL-71-0004 (Hildenbrand, Donald L., and Murad, Edmond) Dissociation Energy of NaO(g) and the Heat of Atomization of Na₂O(g).
- AFCRL-71-0032 (Huffman, Paul) Polarization of Light Scattered by Ice Crystals.
- AFCRL-71-0033 (Logan, Lloyd M., and Hunt, Graham R.) Emission Spectra of Particulate Silicates Under Simulated Lunar Conditions.
- AFCRL-71-0034 (Golomb, D., Dyer, G. L., and Kitrosser, D. F.) The H-NO Chemiluminescence Using Adiabatically Expanded NO.

- AFCRL-71-0035 (Hall, L.A., and Hinteregger, H.E.) Solar Radiation in the Extreme Ultraviolet and Its Variation With Solar Rotation.
- AFCRL-71-0036 (Swider, W.) Sources for H₃O⁺ · (H₂O)_n lons in the D Region.
- AFCRL-71-0037 (Tsacoyeanes, C., and Levine, M.A.) Electronic Enhancement of Photodetector Performance.
- AFCRL-71-0038 (Fang, P.H., Tarko, H., and Drevinsky, P.J.) Impurity Effects on Annealing of Radiation Defects in p-Type Silicon.
- AFCRL-71-0042 (Wolnik, S.J., Berthel, R.O., and Wares, G.W.) Shock-Tube Measurements of Absolute gf-Values for Fe I.
- AFCRL-71-0043 (Buchau, Jurgen, and Whalen, James A.) On the Continuity of the Auroral Oval.
- AFCRL-71-0044 (Best, G. T.) Optical Instrumentation for Tracking High Altitude Vapor Releases by Day.
- AFCRL-71-0045 (Izumi, Yutaka, and Barad, Morton L.) Wind Speeds as Measured by Cup and Sonic Anemometers and Influenced by Tower Structure.
- AFCRL-71-0046 (Hunt, G.R., and Logan, L.M.) An Image Selection Device for Use with a Telescope.
- AFCRL-71-0047 (Donaldson, Ralph J., Jr.) Mapping a Thunderstorm Anvil Flow by Doppler Radar.
- AFCRL-71-0048 (Slobodnik, A.J., Jr., Carr, P.H., and Budreau, A.J.)
 Microwave Frequency Acoustic Surface-Wave Loss Mechanisms on LiNbO3.
- AFCRL-71-0050 (Croom, D.L.) 19-Gigahertz (1.58-Centimeter) Solar Radio Bursts as Indicators of Proton Events.
- AFCRL-71-0051 (Ben-Yosef, N., and Rubin, A.G.) Optical Investigations of Electrostatic Turbulence in Plasma.
- AFCRL-71-0052 (Izatt, Jerald R.) Spectral Anomalies Due to Inhomogeneous Optical Pumping in the Ruby Laser.
- AFCRL-71-0053 (Rush, C.M., St. John, D.E., and Venkateswaran, S.V.) A Unified Description of the Tidal Effects in f₀F₂.
- AFCRL-71-0066 (Salmela, H.A., and Sissenwine, N.) A Note on Errors in the Upper Air Humidity Climatology.
- AFCRL-71-0069 (Hoffman, Herbert S.) Ionic Spectra of Meteors.
- AFCRL-71-0070 (Croom, D. L.) Solar Microwave Bursts as Indicators of the Intensity of Solar Proton Emissions.
- AFCRL-71-0071 (Plendl, J.N.) Characteristic Spectra of Energy Absorption for Dielectric Solids.
- AFCRL-71-0086 (Paulson, John F., Dale, Fred, and Studniarz, Stanley A.) Study of Ion-Neutral Reactions With a Time-of-Flight Double Mass Spectrometer.

AFCRL-71-0099 (Fairbairn, A.R.) Band Strengths in Forbidden Transitions: The Cameron Bands of CO.

- AFCRL-71-0100 (Radoski, Henry Robert) The Resonance Barrier Theory of Hydromagnetic Waves.
- AFCRL-71-0101 (Aaerons, Jules, and Allen, Richard S.) Scintillation Boundary During Quiet and Disturbed Magnetic Conditions.
- AFCRI.-71-0102 (Fisher, E.S., and Manghnani, M.H.) Effect of Axial Ratio Changes on the Elastic Moduli and Gruneisen for Lower Symmetry Crystals.
- AFCRL-71-0103 (Fujimori, Eiji) pH-Induced Reversible Changes in the Absorption Spectrum and Photoactivity of Bacteriochlorophyll in Photosynthetic Bacterio Chromatophores.
- AFCRL-71-0122 (Plendl, J. N.) Damping of Lattice Vibrations in Solids.
- AFCRL-71-0128 (Oldenberg, O.) James Franck at Göttingen.
- AFCRL-71-0129 (Huffman, P.J., and Ohtake, T.) Formation and Growth of Ice Fog Particles at Fairbanks, Alaska.
- AFCRL-71-0130 (Hyder, Charles L.) Strong Coronal Shocks and 'Thermal' Solar X-Ray Bursts.
- AFCRL-71-0131 (Hyder, Charles L., and Lites, Bruce W.) H α Doppler Brightening and Lyman- α Doppler Dimming in Moving H α Prominences.
- AFCRL-71-0154 (Straka, Ronald M., and Castelli, John P.) Observations at the Sagamore Hill Sola: Radio Observatory.
- AFCRL-71-0155 (Falcone, Vincent J., Wulfsberg, Karl N., and Gitelson, Samuel) Atmospheric Emission and Absorption at Millimeter Wavelengths.
- AFCRL-71-0156 (Prasad, B., Sen, Hari K., Bakshi, P., and Kalman, G.)
 Nonlinear Collisionless Plasma Waves and Intensity of the Flectric Field of
 the Ionospheric Irregularities.
- AFCRL-71-0157. (Krishna, P., Marshall, R.C., and Ryan, C.E.) The Discovery of a 2H-3C Solid State Transformation in Silicon Carbide Single Crystals.
- AFCRL-71-0158 (Huffman, R.E., Paulsen, D.E., Larrabee, J.C., and Cairns, R.B.) Decrease in D-Region O₂ (Δg) Photoionization Rates Resulting From CO₂ Absorption.
- AFCRL-71-0159 (Hayes, Dallas T.) Meaning of Kato's Formulas for Upper and Lower Bounds to Eigenvalues of Hermitian Operators.

Contractor Reports

AFCRL-70-0180 (University of Connecticut) The Analysis of Hydrogen-Carbon Ratios in Carbonaceous Residues.

INDEX

- AFCRL-70-0468 (University of California, Irvine, School of Engineering)
 Investigation of Spectral and Statistical Properties of Single-Mode CW Lasers.
- AFCRL-70-0482 (EMR Division of Weston Instruments, Inc.) New Charged Particle Detectors.
- AFCRL-70-0484 (Harvard University, Harvard College Observatory) Fine Structure in Ca II c: the Solar Disc.
- AFCRL-70-0489 (Hawaii Institute of Geophysics, University of Hawaii) The Mean Tropospheric Circulation and Cloudiness Over Southeast Asia and Neighboring Areas.
- AFCRL-70-0512 (Northeastern University, Solid State Spectroscopy Lab, Physics Dept.) The Study of the Reflectivity of Inorganic Materials Important for Remote Sensing Applications.
- AFCRL-70-0513 (Massachusetts Inst. of Technology, Dept. of Meteorology)
 The Measurement of Small Scale Velocity Structure in the 30-60 KM Region
 by the Smoke Trail Method.
- AFCRL-70-0581 (Analysis & Computer Systems, Inc.) Mathematical Analysis and Computer Oriented Environmental Studies.
- AFCRL-70-0583 (Defense Systems Div., Univac Div. of Sperry Rand Corp.) Galots Logic Design.
- AFCRL-70-0587 (Harvard University, Div. of Engineering and Applied Physics) Structural Properties of Grammars and Languages.
- AFCRL-70-0588 (University of New Hampshire, Antenna Systems Lab., Dept. of Electrical Engineering) An Interferometer System for the Measurement of the Azimuth of Radar Echoes from Meteor Trails.
- AFCRL-70-0594 (Dept. of Geology, University of Kansas) Radiation Damage and Chemical Reactions Induced in Crystalline Solids by High-Energy Proton Bombardment.
- AFCRL-70-0598 (Stanford Research Institute) Visibility Measurement for Aircraft Landing Operations.
- AFCRL-70-0605 (Tyco Laboratories, Inc.) Purification and Analysis of Organic Non-aqueous Solvents.
- AFCRL-70-0615 (Dept. of Physics and Astronomy, University of Hawaii)
 Study of Scattering and Fluorescence of Gases in the Vacuum Ultraviolet.
- AFCRL-70-0643 (McDonnell Douglas Astronautics Co.) A Potential High Energy Resolution Iodine Negative Ion Source.
- AFCRL-70-0648 (Sperry Rand Research Center) Experimental and Theoretical Studies Into Pulse and Wave Phenomena In Plasmas.
- AFCRL-70-0655 (University of Hawaii, Dept. of Electrical Engineering) A Study of Problems in Information Processing.
- AFCPL-70-0657 (Electrical Engineering Dept., Syracuse University) Theory and Computation of Characteristic Modes for Conducting Bodies.

155

AFCRL-70-0558 (University of Utah, Upper Air Research Laboratory) Rocket Instrumentation for Auroral Measurements Aerobees 3.756 and 3.759.

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- AFCRL-70-0664 (University of Cincinnati) Research in Airglow Phenomena.
- AFCRL-70-0667 (American Science & Engineering) The Growth of Single Crystals of the Charge Transfer Complexes.
- AFCRL-70-0682 (Raytheon Co., Missile Systems Division) Analysis and Element Pattern Design of Periodic Arrays of Circular Apertures on Conducting Cylinders.
- AFCRL-70-0684 (Dept. of Physics, Clarkson College of Technology) Spark Chamber Spectrometry and Space Radiation Studies.
- AFCRL-70-0696 (University of Washington, College of Engineering, Dept. of Electrical Engineering) Temporal Frequency Spectra of Multifrequency Waves in a Turbulent Atmosphere.
- AFCRL-70-0700 (Analysis & Computer Systems, Inc.) Satellite Experiment Processor System.
- AFCRL-70-0701 (Colorado School of Mines, Dept. of Geophysics) Evaluation of Airborne Electromagnetic Surveying for Mapping Variations in Rock Strength.
- AFCRL-70-0702 (General Electric Co., Re-Entry & Environmental Div.) Shock Layer Ionization at High Altitudes.
- AFCRL-70-0703 (Northeastern University) Investigation of Solid State Devices and Design of Electronic and Electro-Optical Measuring Equipment.
- AFCRL-70-0704 (Lamont-Doherty Geological Observatory of Columbia University) Seismicity Map of the Arctic Compiled from ESSA, Coast and Geodetic Survey, Epicenter Data January 1961 Through September 1969.
- AFCRL-70-0707 (Colorado State University, Dept. of Electrical Engineering)
 Causes, Effects and Diagnostic Measurements of the Reentry Plasma Sheath.
- AFCRL-70-0710 (Cruft Lab., Div. of Engineering and Applied Physics, Harvard University) Experimental Study of Coupled Linear Antennas in an Inhomogeneous Dissipative Medium.
- AFCRL-70-0711 (RCA Electronic Components, Electro-Optics Devices Lab., David Sarnoff Research Center) Investigation of Solid State Cold Cathodes.
- AFCRL-70-0715 (Colorado State University, Dept. of Electrical Engineering)
 Antennas in Compressible Plasmas.
- AFCRL-70-0717 (University of New Hampshire, Antenna Systems Lab., Dept. of Electrical Engineering) Computer Processing of Data From the UNH/AFCRL Meteor Trails Radar.
- AFCRL-71-0005 (GCA Corp., GCA Technology Div.) Rocket-Borne Photometer Investigation of Noctilucent Clouds.
- AFCRL-71-0009 (Lamont-Doherty Geological Observatory of Columbia University)
 Three-Dimensional Seismic Ray Tracing in a Laterally Heterogeneous Spherical
 Earth.

- AFCRL-71-0012 (Colorado State University, Dept. of Electrical Engineering)
 Microwave Reentry Plasma Diagnostics.
- AFCRL-71-0012 (Sylvania Electronic Systems, An Operating Group of Sylvania Electric Products, Inc.) Algebraic Theory of Codes II.
- AFCRL-71-0014 (Electrical Engineering Dept., Syracuse University) Computer Programs for Characteristic Modes of Bodies of Revolution.
- AFCRL-71-0015 (University of Tennessee) Evaluation of Remote Sensor Images for Analysis of the System: Water-Vegetation-Soil-Rock-Topography in the Asheville Basin A1 ea, North Carolina.
- AFCRL-71-0016 (Massachusetts Inst. of Technology, Aerophysic Laboratory)
 Alleviation of the Plasma Boundary Layer by Chemical Injection.
- AFCRL-71-0020 (Radioscience Laboratory, Stanford Electronics Labs., Stanford University) Line-of-Sight Propagation of Millimeter Radio Waves.
- AFCRL-71-0023 (AVCO Corporation, Systems Division) Considerations for Non-Linear Microwave Breakdown and Propagation.
- AFCRL-71-0024 (IBM Corp., Components Div., East Fishkill Laboratory) Crystal Propercies as Influenced by Crystallographic Imperfections.
- AFCRL-71-0039 (Materials Research Laboratory, The Pennsylvania State University) Investigation of Nucleation Sites in Gels.
- AFCRL-71-0054 (Parke Mathematical Laboratories, Inc.) Research on Radiation Effects in Solids.
- AFCRL-71-0062 (Lamont-Doherty Geological Observatory of Columbia University) Structure and Evolution of the Mobile Seisnic Belts.
- AFCRL-71-0067 (Rosenstiel School of Marine and Atmospheric Science, Div. of Atmospheric Science, University of Miami) Seasonal Variations of the Inter-Tropical Convergence Zone Studied with an Interacting Atmosphere and Ocean Model.
- AFCRL-71-0072 (Lowell Technological Institute Research Foundation) Design and Fabrication of Sounding Rocket Payloads.
- AFCRL-71-0073 (Accumetrics Corp.) Flight Data Analysis and Electromechanical Simulation of Sounding Rocket Stability.
- AFCRL-71-0084 (Dept. of Physics, University College London) Upper Atmosphere Neutral Temperature Profiles in the Auroral Zone 1968-1970.
- AFCRL-71-0085 (Dept. of Physics, University College London) Ionospheric Winds in the Auroral Zone.
- AFCRL-71-0091 (Perkin-Elmer Corp.) Transient and Steady-State Electrostrictive Laser Beam Trapping.
- AFCRL-71-0108 (Dept. of Electrical and Electronic Engineering, The University of Leeds) Maximization of Argon-Hydrocarbon Penning Mixtures.
- AFCRL-71-0109 (Dept. of Electrical and Electronic Engineering, The University of Leeds) Aspect of Electric Strength of a Moving Gas.

157

AFCRL-71-0110 (Dept. of Electrical and Electronic Engineering, The University of Leeds) Gaseous Townsend Discharges in Gas Mixtures, in a Crossed Magnetic Field and in a Moving Gas.

INDEX

- AFCRL-71-0117 (University of Illinois, Dept. of Electrical Engineering) Effects of a Dynamo Electric Field on the Thermospheric Winds.
- AFCRL-71-0133 (Institute of Physical Sciences, University of Milan) Albedo Neutron Component of the Earth's Radiation Environment.
- AFCRL-71-0134 (The Royal Inst. of Technology, Physics Department)
 Consecutive Ion-Molecule Reactions in Acetylene Investigated by Charge
 Exchange Mass Spectrometry.
- AFCRL-71-0135 (The Technical University of Denmark, Laboratory of Electromagnetic Theory) Influence of Variation of Backfire Antenna Parameters. II: Short-Backfire Antenna.